Onan®

MAJOR SERVICE MANUAL

FOR

ELECTRIC GENERATING SETS

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NH SERIES

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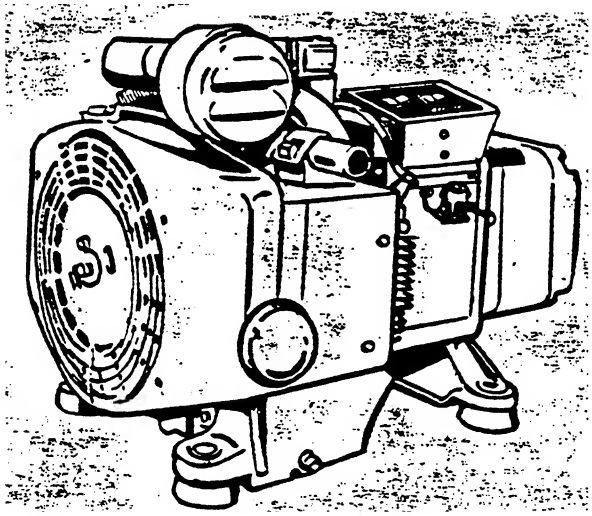

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Important Safety Precautions

Read and observe these safety precautions when using or working on electric generators, engines and related equipment. Also read and follow the literature provided with the equipment.

Proper operation and maintenance are critical to performance and safety. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause severe personal injury or death.

FUEL, ENGINE OIL, AND FUMES ARE FLAMMABLE AND TOXIC

Fire, explosion, and personal injury can result from improper practices.

- Used engine oil, and benzene and lead, found in some gasoline, have been identified by government agencies as causing cancer or reproductive toxicity. When checking, draining or adding fuel or oil, do not ingest, breathe the fumes, or contact gasoline or used oil.
- Do not fill tanks with engine running. Do not smoke around the area. Wipe up oil or fuel spills. Do not leave rags in engine compartment or on equipment. Keep this and surrounding area clean.
- Inspect fuel system before each operation and periodically while running.
- Equip fuel supply with a positive fuel shutoff.
- Do not store or transport equipment with fuel in tank.
- Keep an ABC–rated fire extinguisher available near equipment and adjacent areas for use on all types of fires except alcohol.
- Unless provided with equipment or noted otherwise in installation manual, fuel lines must be copper or steel, secured, free of leaks and separated or shielded from electrical wiring.
- Use approved, non-conductive flexible fuel hose for fuel connections. Do not use copper tubing as a flexible connection. It will work–harden and break.

EXHAUST GAS IS DEADLY

- Engine exhaust contains carbon monoxide (CO), an odorless, invisible, poisonous gas. Learn the symptoms of CO poisoning.
- Never sleep in a vessel, vehicle, or room with a genset or engine running unless the area is equipped with an operating CO detector with an audible alarm.
- Each time the engine or genset is started, or at least every day, thoroughly inspect the exhaust system. Shut down the unit and repair leaks immediately.
- Warning: Engine exhaust is known to the State of California to cause cancer, birth defects and other reproductive harm.

Make sure exhaust is properly ventilated.

- Vessel bilge must have an operating power exhaust.
- Vehicle exhaust system must extend beyond vehicle perimeter and not near windows, doors or vents.
- Do not use engine or genset cooling air to heat an area.
- Do not operate engine/genset in enclosed area without ample fresh air ventilation.
- Expel exhaust away from enclosed, sheltered, or occupied areas.
- Make sure exhaust system components are securely fastened and not warped.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not remove any guards or covers with the equipment running.
- Keep hands, clothing, hair, and jewelry away from moving parts.
- Before performing any maintenance, disconnect battery (negative [–] cable first) to prevent accidental starting.
- Make sure fasteners and joints are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- If adjustments must be made while equipment is running, use extreme caution around hot manifolds and moving parts, etc. Wear safety glasses and protective clothing.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- Always disconnect battery negative (–) lead first and reconnect it last. Make sure you connect battery correctly. A direct short across battery terminals can cause an explosion. Do not smoke while servicing batteries. Hydrogen gas given off during charging is explosive.
- Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the area thoroughly.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can be ignited by equipment operation or cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. **Do not operate diesel equipment where a flammable vapor environment can be created by fuel spill, leak, etc., unless equipped with an automatic safety device to block the air intake and stop the engine.**

HOT COOLANT CAN CAUSE SEVERE PERSONAL INJURY

- Hot coolant is under pressure. Do not loosen the coolant pressure cap while the engine is hot. Let the engine cool before opening the pressure cap.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not service control panel or engine with unit running. High voltages are present. Work that must be done while unit is running should be done only by qualified service personnel.
- Do not connect the generator set to the public utility or to any other electrical power system. Electrocution can occur at a remote site where line or equipment repairs are being made. An approved transfer switch must be used if more than one power source is connected.
- Disconnect starting battery (negative [–] cable first) before removing protective shields or touching electrical equipment. Use insulative mats placed on dry wood platforms. Do not wear jewelry, damp clothing or allow skin surface to be damp when handling electrical equipment.
- Use insulated tools. Do not tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- With transfer switches, keep cabinet closed and locked. Only authorized personnel should have cabinet or operational keys. Due to serious shock hazard from high voltages within cabinet, all service and adjustments must be performed by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move genset operation switch or Stop/Auto/Handcrank switch (whichever applies) to Stop.
2. Disconnect genset batteries (negative [–] lead first).
3. Remove AC power to automatic transfer switch. If instructions require otherwise, use extreme caution due to shock hazard.

MEDIUM VOLTAGE GENERATOR SETS (601V TO 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training are required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Induced voltage remains even after equipment is disconnected from the power source. Plan maintenance with authorized personnel so equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Do not work on equipment when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Never step on equipment (as when entering or leaving the engine compartment). It can stress and break unit components, possibly resulting in dangerous operating conditions from leaking fuel, leaking exhaust fumes, etc.
- Keep equipment and area clean. Oil, grease, dirt, or stowed gear can cause fire or damage equipment by restricting airflow.
- Equipment owners and operators are solely responsible for operating equipment safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

KEEP THIS DOCUMENT NEAR EQUIPMENT FOR EASY REFERENCE.

TABLE OF CONTENTS

GENERAL INFORMATION

This manual contains information concerning proper maintenance, servicing, and overhaul of Onan NH electric generating sets. Onan recommends that you study the entire manual to better understand how the unit functions. This will help in maintenance and servicing of the unit, which results in longer unit life and more reliable operation.

If possible use the parts catalog in conjunction with this service manual. The parts catalog gives a good picture of unit assembly and disassembly and helps in identifying specific component parts.

A troubleshooting chart is included in this manual to aid in correct diagnosis of unit problems. Also note the special tools list included in this manual.

When discussing the front, rear, left, and right of the unit always view it from the engine end which is considered the front.

HOW TO INTERPRET MODEL AND SPEC NO.

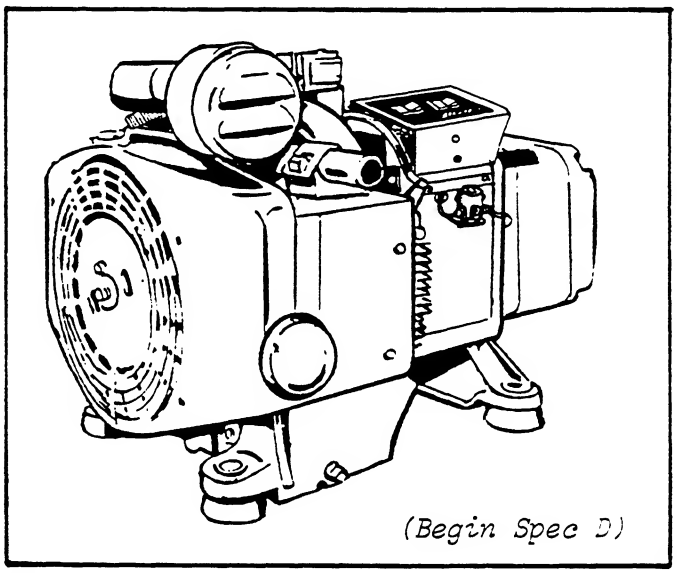
6.5NH - 3CR / 6000 A

1 2 3 4

1. Factory code for series identification.
2. Combines with number 1 to identify model. Indicates model, output voltage, method of starting: E-electric starting, R-remote starting.
3. Factory code for designating optional equipment.
4. Specification letter (Advances when the factory makes production modifications).

CAUTION *Onan uses this symbol throughout the text to warn of possible equipment damage.*

WARNING *This symbol is used to warn of any possible personal injury.*



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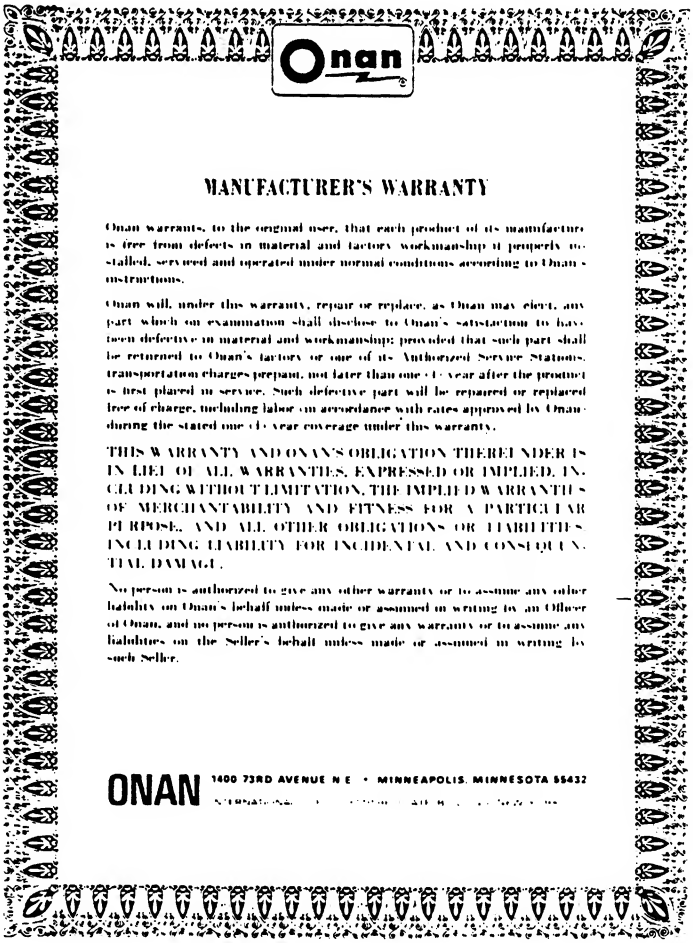


Onan

MANUFACTURER'S WARRANTY

Onan warrants, to the original user, that each product of its manufacture is free from defects in material and factory workmanship if properly installed, serviced and operated under normal conditions according to Onan instructions.

Onan will, under this warranty, repair or replace, as Onan may elect, any part which on examination shall disclose to Onan's satisfaction to have been defective in material and workmanship; provided that such part shall be returned to Onan's factory or one of its Authorized Service Stations, transportation charges prepaid, not later than one (1) year after the product is first placed in service. Such defective part will be repaired or replaced free of charge, including labor in accordance with rates approved by Onan during the stated one (1) year coverage under this warranty.

THIS WARRANTY AND ONAN'S OBLIGATION THEREUNDER IS IN LIEU OF ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES INCLUDING LIABILITY FOR INCIDENTAL AND CONSEQUENTIAL DAMAGE.

No person is authorized to give any other warranty or to assume any other liability on Onan's behalf unless made or assumed in writing by an Officer of Onan, and no person is authorized to give any warranty or to assume any liabilities on the Seller's behalf unless made or assumed in writing by such Seller.

ONAN 1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432

SPECIFICATIONS

Dimensions	
Height	20-13/16"
Width	20-9/16"
Length	20-9/16"
Horsepower	14.0-bph at 1800 rpm
Number of Cylinders (Opposed)	2
Displacement (cubic inches)	60.0"
Cylinder Bore	3-9/16"
Piston Stroke	3"
RPM (60 Hertz)	1800 rpm
RPM (50 Hertz)	1500 rpm
Compression Ratio (Gasoline Fuel)	7.0 to 1
Oil Capacity (Quarts)	4.0 (4.5 with filter change
Oil Filter	1-2 quart, spin-on
Battery Voltage (Remote Start AC Plants)	12
Battery Size (Remote Start AC Plants)	72 amp hr.
Starting System	Exciter Cranking
Battery Charge Rate (Amperes)	2-5 (adjustable)
Ventilation Required (CFM at 1800 rpm)	
Generator Set	600 cfm
Generator Set (Vacu-Flo)	530 cfm
AC Voltage Regulation in %	13
AC Frequency Regulation in %	3 Hertz (5%) No Load to Rated Load
Fuel	Regular Grade
Fuel Pump	Diaphragm, 4 ft. Lift

TUNE-UP SPECIFICATIONS

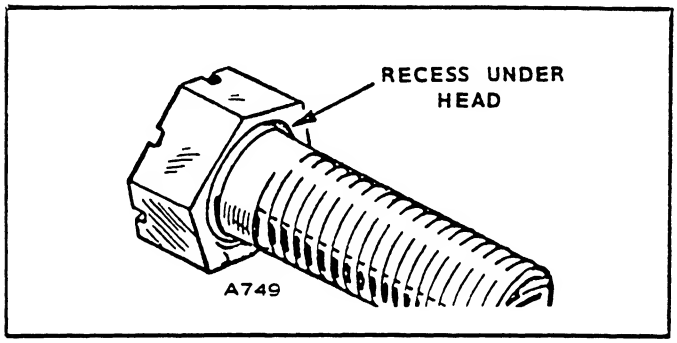
Spark Plug Gap	.025"
Breaker Point Gap	.020"
Ignition Timing	
Stopped	3° ATC
Running	22° BTC
Mobile Model	19° BTC
Tappets (Cold) Intake	.003"
Exhaust	.012"

ASSEMBLY TORQUES AND SPECIAL TOOLS

TORQUE

Assembly torques as given here require the use of a torque wrench. These assembly torques will assure proper tightness without danger of stripping the threads. If a torque wrench is not available, you will have to estimate the degree of tightness necessary for the stud, nut or screw being installed and tighten accordingly. Be careful not to strip the threads. Check all studs, nuts and screws often with the engine cold. Tighten as needed to prevent them from working loose.

Special Place Bolts do not require lockwashers or gaskets. Never attempt to use a lockwasher with these bolts, it will defeat their purpose. Check all studs, nuts and screws often. Tighten as needed.



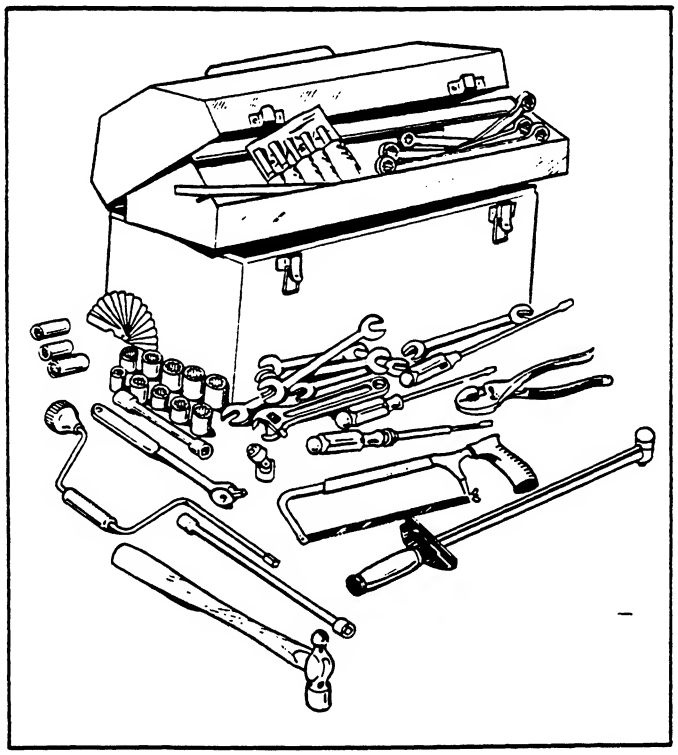
TORQUE SPECIFICATIONS IN LB-FT

	Min.	Max.
Connecting Rod Bolt	27	29
Flywheel Mounting Screw	30	40
Fuel Pump Mounting Screws	5	6
Oil Pump	7	9
Gearcase Cover	8	10
Rear Bearing Plate	25	27
Oil Base Mounting Screws	18	23
Cylinder Head Bolt	17	19
Spark Plugs	15	20
Valve Cover Nut	4	8
Manifold Screws - Intake and Exhaust	10	23
Magneto Stator Screws	8	10
Carburetor Mounting Stud Nuts	8	12
Armature Through Stud Nut	35	40
Generator Through Stud Nut	14	16
Blower Housing Screws	10	15
Generator Adapter - To Cylinder Block	15	18

SPECIAL TOOLS

These tools are available from Onan to aid service and repair work.

Crankshaft Gear Pulling Ring	420-0248
Main Crankshaft Bearing Driver	
Front and Rear	420-0067
Camshaft Bearing Driver	
Front	420-0066
Rear	420-0307
Valve Seat Driver	420-0308
Valve Seat Staker	
Intake	420-0309
Exhaust	420-0310
Valve Seat Cutter	420-0311
Oil Seal Guide and Driver - Bearing Plate	420-0181
Oil Seal Guide and Driver - Gear Cover	420-0313
Camshaft Bearing Remover	420-0314
Crankshaft Bearing Remover	420-0315
Combination Main Cam and Bearing Drive	420-0324



NOTE: *A tool catalog, listing all special tools, is available from Onan.*

DIMENSIONS AND CLEARANCES

ALL CLEARANCES GIVEN AT ROOM TEMPERATURE OF 70°F

	Minimum	Maximum
Valve Tappet Clearance		
Intake	0.003*	
Exhaust	0.010*	
Valve Stem in Guide – Intake	0.001″	0.0025″
Valve Stem in Guide – Exhaust	0.0025″	0.004″
Valve Spring Length		
Free Length	1.662″	
Compressed Length	1.375″	
Valve Spring Tension (lb.)		
Open	71	79
Closed	38	42
Valve Seat Bore Diameter		
Intake	1.5645″	1.5655″
Exhaust	1.2510″	1.2520″
Valve Seat Diameter		
Intake	1.569″	1.570″
Exhaust	1.255″	1.256″
Valve Stem Diameter		
Intake	0.3425″	0.3430″
Exhaust	0.3410″	0.3415″
Valve Guide Diameter (I.D.)	0.344″	0.346″
Valve Lifter Diameter	0.7475″	0.7480″
Valve Lifter Bore	0.7505″	0.7515″
Valve Seat Interference Width	1/32″	3/64″
Valve Face Angle	44°	
Valve Seat Angle	45°	
Valve Interference Angle	1°	
Crankshaft End Play	0.005″	0.009″
Camshaft Bearing	0.0015″	0.003″
Camshaft End Play	0.003″	–
Camshaft Lift	0.033″	
Camshaft Bearing Diameter	1.3760″	1.3770″
Camshaft Journal Diameter	1.3740″	1.3745″
Rod Bearing (Forged Rod)	0.0005″	0.0023″
Connecting Rod End Play (Ductile Iron)	0.002″	0.016″
Timing Gear Backlash	0.002″	0.003″
Oil Pump Gear Backlash	0.002″	0.005″
Piston to Cylinder, Strut Type (Measured below oil-controlling ring – 90° from pin) Clearance	0.0015″	0.0035″
Piston Pin Diameter	0.7500″	0.7502″
Piston Pin in Piston	Thumb Push Fit	
Piston Pin in Rod	0.0002″	0.0007″
Piston Ring Groove Width		
Top 1	0.0955″	0.0965″
Top 2	0.0955″	0.0965″
Top 3	0.1880″	0.1890″
Piston Ring Gap in Cylinder	0.010″	0.020″
Piston Ring Side Clearance (Top compression ring only)	0.006″	
Breaker Point Gap (Full Separation)	0.020″	

*±0.001″

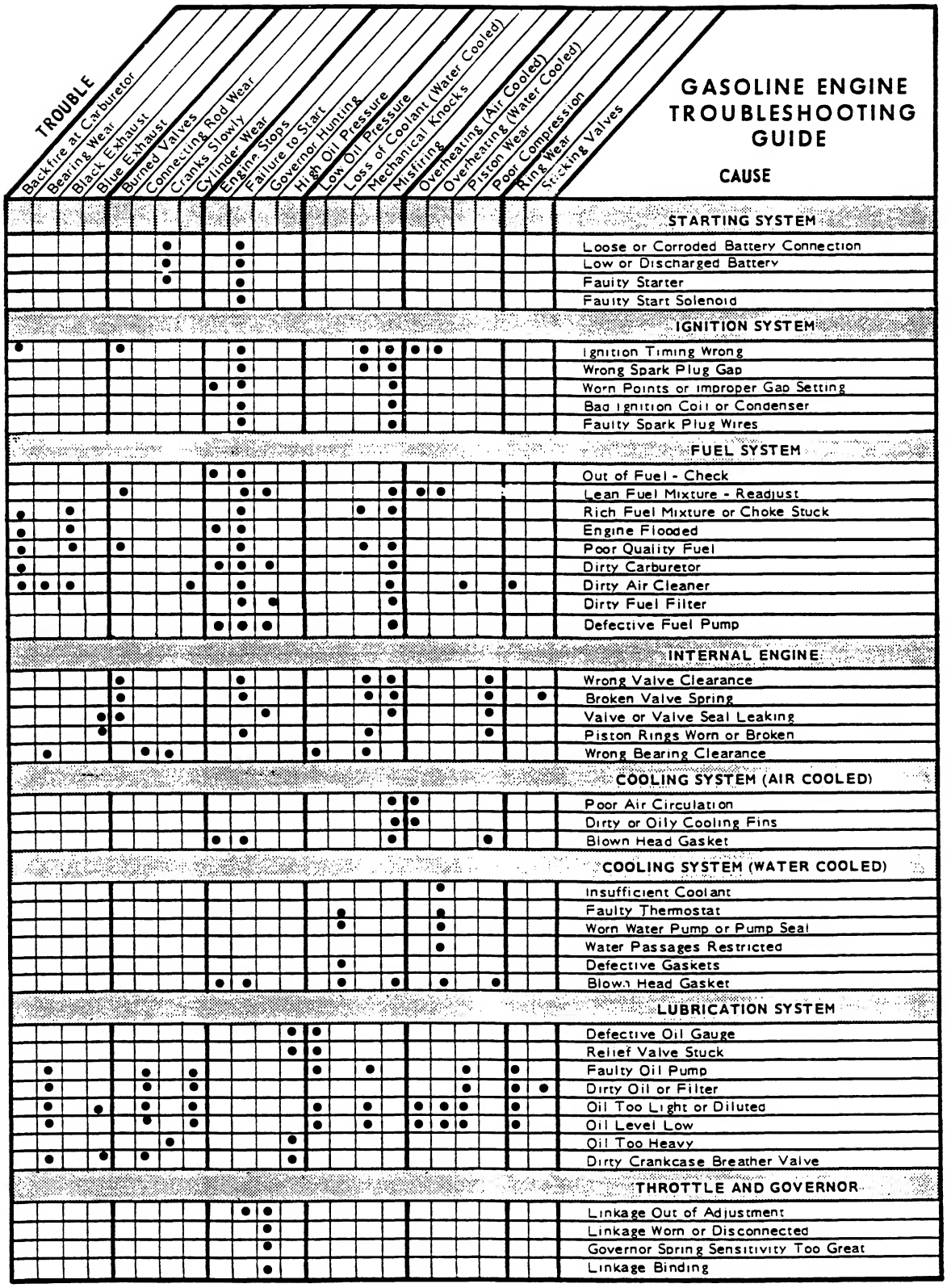
Spark Plug Gap – For Gasoline Fuel	0.025″	
Crankshaft Main Bearing Journal – Standard Size	1.9992″	2.000″
Main Bearing Diameter	2.0015″	2.0040″
Main Bearing Clearance	0.0015″	0.0043″
Crankshaft Rod Bearing Journal – Standard Size	1.6252″	1.6260″
Cylinder Bore – Standard Size	3.5625″	3.5635″
Ignition Timing		
Stopped	3°ATC	
Running	22°BTC	
Mobile Model	19°BTC	
Magneto Pole Shoe Air Gap	0.010″	0.015″

PERIODIC SERVICE GUIDE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS					
	8	100	200	500	1000	5000
Inspect Plant Generally	x					
Check Fuel Supply	x					
Check Oil Level	x					
Check Governor Linkage		x*				
Service Air Cleaner		x*				
Change Crankcase Oil		x*£				
Clean Crankcase Breather			x			
Check Breaker Points			x			
Check Battery Electrolyte Level			x			
Empty Fuel Sediment Bowl			x			
Replace Oil Filter			x			
Inspect Generator Brushes				x		
Clean Breather Baffle				x		
† Check Valve Clearance				x		
Clean Rocker Cover Oil Line Holes					x	
Inspect Valves, Grind if Necessary					x	
Clean Generating Plant					x	
Complete Reconditioning						x

* - Service more often under extreme dust conditions.
£ - Service every 50 hrs. under high temperature conditions (100°F and above).
† - Tighten head bolts and adjust valve clearance after first 50 hours on a new or overhauled engine.

GASOLINE ENGINE TROUBLESHOOTING GUIDE



COOLING SYSTEM

GENERAL

NH electric generating sets use a pressure air cooling system. Blades on the engine flywheel draw the air into the front of the engine housing and force it past all the cylinders and out the rear of the engine. A separate blower on the generator rotor draws air into the rear of the generator and forces it out openings near the engine.

MAINTENANCE

Clean the engine cooling area (fins on the cylinder block and cylinder heads) at regular intervals, normally every 1000 hours, but sooner under dirty operating conditions.

OVERHEATING

The most common causes of overheating are dirty cooling surfaces, operating without the engine air housing and incorrect unit installation. The first sign of overheating is usually vapor lock in the fuel system followed by scoring of the pistons. If there are any signs that overheating is occurring, the unit should be immediately shut down.

CAUTION *The air housing must be on when operating the engine. Overheating and permanent engine damage could result from as little as one minute of full load operation.*

The most common installation problems causing overheating are:

1. Installation with duct size too small to allow sufficient air flow.
2. Installation in small room with no ducts and insufficient air ventilation.
3. Installation of air inlet and outlet ducts are too close together so the outlet air feeds back into the inlet duct.

VACU-FLO COOLING

The mobile version of the NH generating set is equipped with Vacu-Flo cooling. Vacu-Flo cooling uses a centrifugal fan to pull cool air into the cooling ducts and over the cooling fins and surfaces of the engine. Heated air is discharged through a discharge opening located at the bottom of the unit. Should a Vacu-Flo set chronically overheat the most likely sources of the problem are:

1. Air inlet to the generating set compartment is obstructed or too small to allow proper ventilation.
2. The air seal at the bottom of the unit is not properly installed. This seal prevents warm, exhaust air from leaking back into the generating set compartment.
3. Air discharge opening partially blocked by external ducts or vehicle exhaust systems.
4. Recirculation of heated air into fresh air inlet.

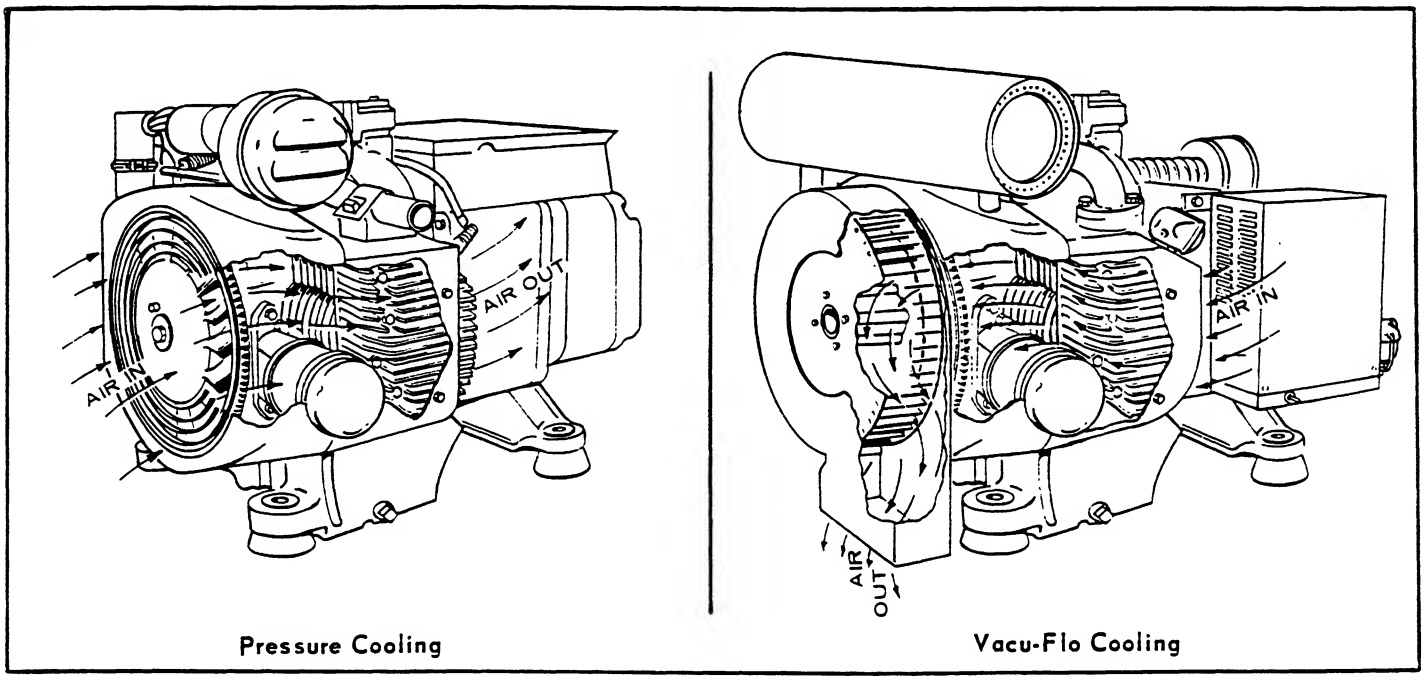


FIGURE 1. GENERATING SET COOLING SYSTEMS

FUEL SYSTEM

GENERAL

The engine of the NH electric generating set uses a gasoline carbureted fuel system to deliver a mixture of fuel and air to the combustion chamber. The fuel system draws fuel from the gasoline tank, delivers it through a fuel filter and fuel pump to the carburetor float chamber. Air passing through the carburetor venturi section of the carburetor draws fuel from the float chamber.

FUEL

Use only a high quality, regular grade of gasoline in the NH generating sets.

CARBURETOR, GASOLINE

Keep the carburetor clean. Some types of gasoline have a tendency to form gum deposits inside the carburetor. Gum deposits can usually be removed by soaking the carburetor in alcohol or acetone. A fine wire may be used to clean the jets. See Figure 2 for a view of the carburetor assembly.

Cleaning and Repair: To clean the carburetor soak all components thoroughly in a good carburetor cleaner and follow the cleaner manufacturer's instructions. Be sure all carbon is cleaned from the carburetor bore, especially in the area of the throttle valve. Blow out the passages with compressed air. If possible, avoid using wire to clean out the passages.

Check the adjusting needles and nozzle for damage. If the float is loaded with fuel or damaged, replace it. The float should fit freely on its pin without binding. Invert the carburetor body and measure the float level.

If necessary, bend the small lip on which the intake valve rides to adjust float level.

Check the choke and throttle shafts for excessive side play and replace if necessary.

REMOVAL AND DISASSEMBLY

1. Remove the fuel line, air cleaner hose, governor linkage and choke wires.
2. Remove the two carburetor mounting nuts and remove the carburetor.
3. If the engine is equipped with an automatic choke,

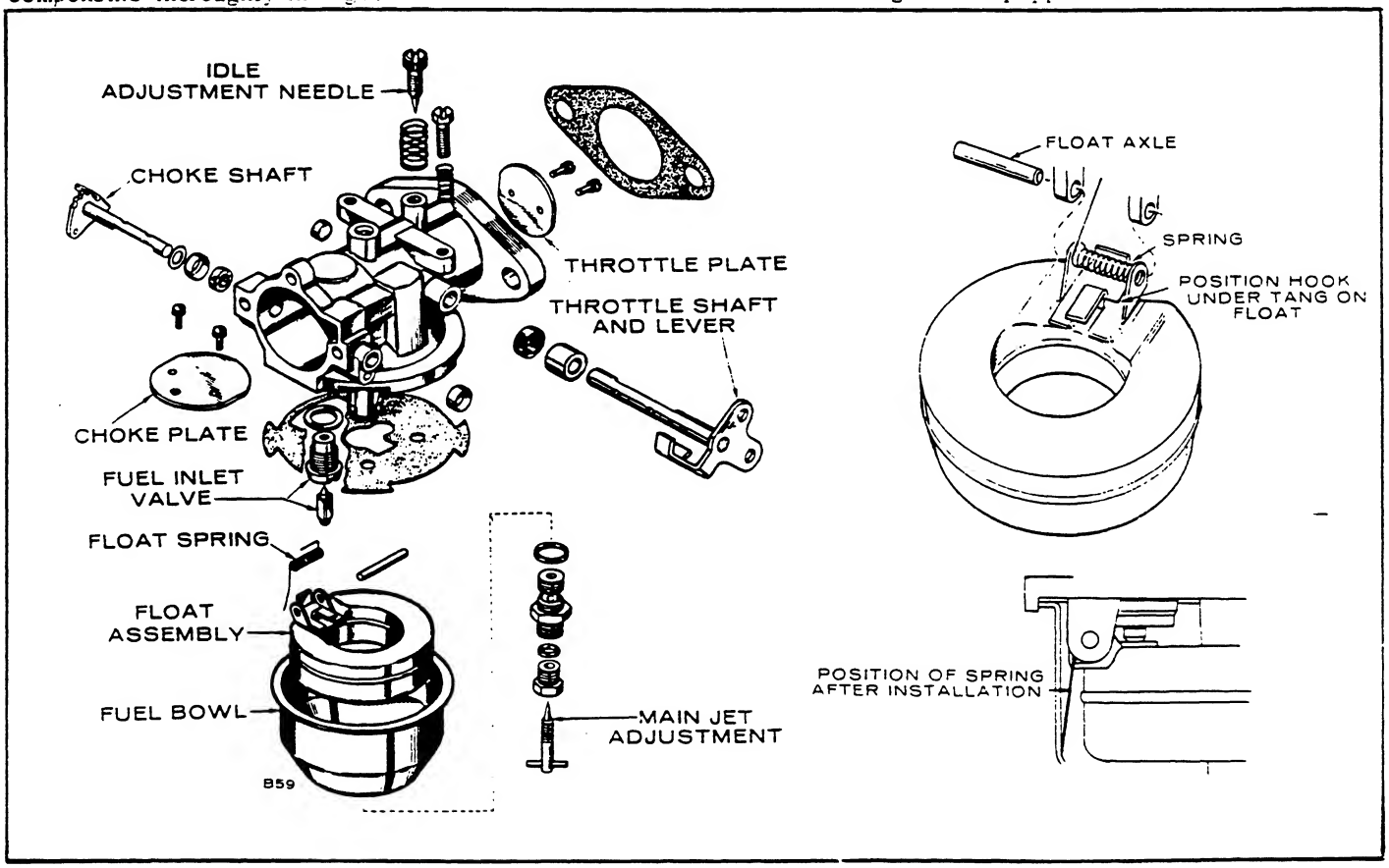


FIGURE 2. CARBURETOR ASSEMBLY

remove the two screws that fasten the choke to the carburetor and remove the assembly.
4. Remove the main jet assembly and bowl.
5. Remove the float pin and float.
6. Lift out the fuel inlet valve and unscrew the valve seat.
7. Remove the no load adjusting needle.
8. Remove the throttle plate screws and the plate and pull out the throttle shaft.
9. Remove the choke plate screws and plate and pull out the choke shaft.

ASSEMBLY AND INSTALLATION

1. Install the throttle shaft and plate, using new screws and lock washers. Install with bevel mated to the carburetor body. On plates marked with the letter C, install with the mark on the side toward the idle port when viewed from the flange end of the carburetor. To center the plate, back off the top screw, close the throttle lever and seat the plate by tapping it with a small screwdriver. Then tighten the two screws.
2. Install the choke shaft and plate. Center the plate in the same manner as the throttle plate (step 1). Use new screws and lock washers.
3. Install the fuel inlet valve seat and valve.
4. Install the float and float pin. Center the pin so the float bowl does not ride against it.
5. Check the float level with the carburetor casting inverted. See Figure 6.
6. Install the bowl ring gasket, bowl and bowl nut. Make sure that the bowl is centered in the gasket and tighten the main jet assembly securely. Turn in until it seats and back out 1 to 1-1/2 turns.
7. Install the idle adjusting screw finger tight. Then back out 1 to 1-1/2 turns.
8. Install the choke and adjust.
9. Install the carburetor on the engine and connect the gasoline inlet and governor mechanism.
10. Install the air cleaner hose.

THERMAL MAGNETIC CHOKE (Optional)

If the choke will not close, check for binding, incorrect adjustment, or incorrect assembly of the bimetal and heater assembly. If the choke will not open after the engine starts, check for heating. The choke bimetal should be warm to the touch within a minute or two after starting.

To disassemble the choke, refer to Figure 3.

If the heater assembly will not heat properly, check for broken heater wire, high resistance connections or broken lead wires to the bimetal and heater assembly. With the element at room temperature, check the heater resistance with an ohmmeter. The resistance should be about 37.8 to 46.2 ohms for a 12 volt system. If the heater is defective, replace. There must be slack in the lead wires between the choke body and the bimetal and heater assembly. When the start button is engaged, the solenoid should cause the spring loaded lever to contact the solenoid core. If this does not occur, check for broken lead wires or a defective solenoid core.

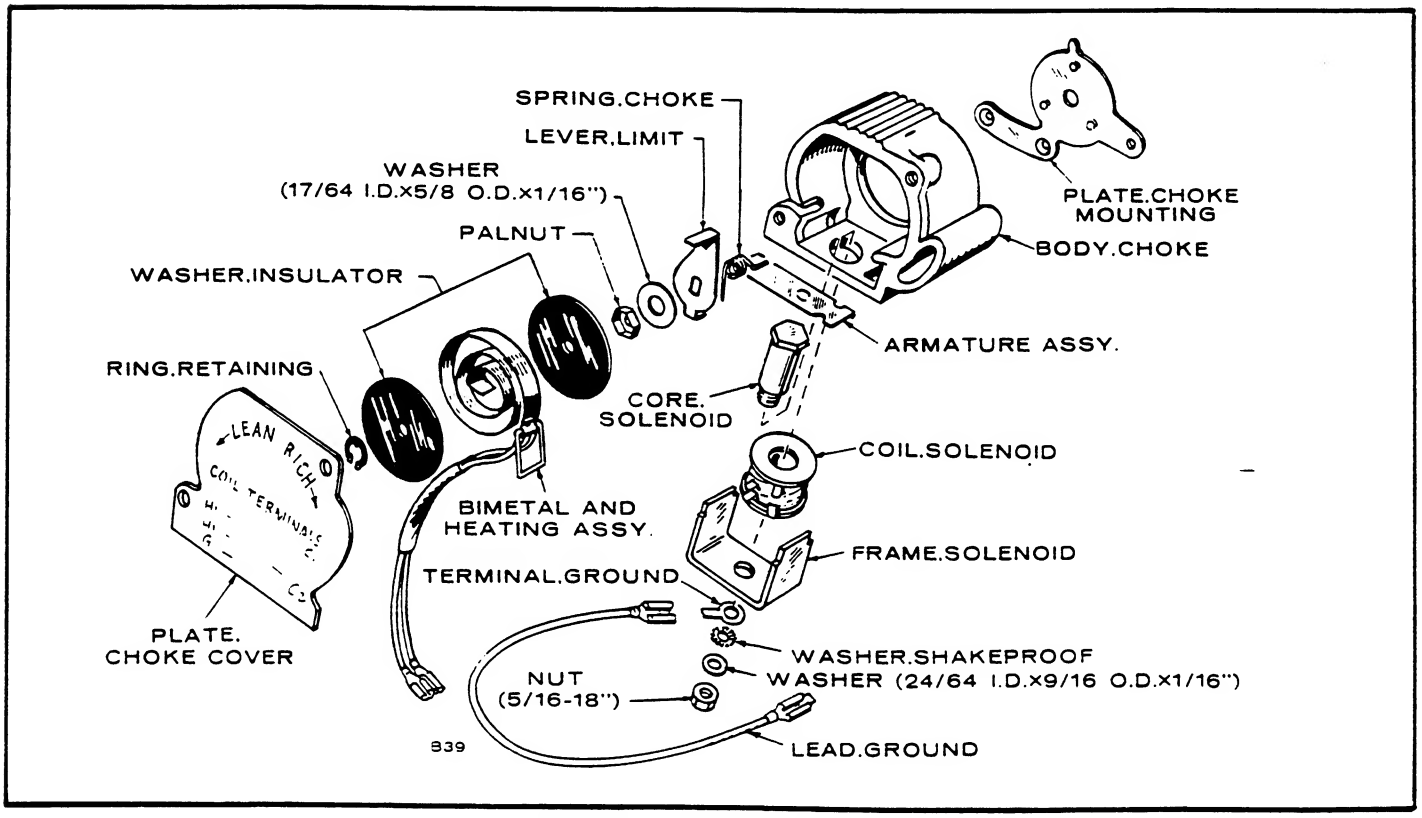


FIGURE 3. CHOKE ASSEMBLY

The solenoid coil should have a resistance of 2.09 to 2.31 ohms in a 12 volt system.

Assembly: Refer to Figure 3. When assembling the thermomagnetic choke, connect the bimetal and heater assembly as follows:

1. Lead tagged G to ground terminal in coil solenoid.
2. Lead tagged H to either of the H1 terminals on the solenoid core.

SISSON CHOKE

This choke uses a heat sensitive bimetal element to control the choke plate position. In addition to this, a solenoid is actuated during engine cranking, closing the choke all the way. The bimetal is factory set to position the choke to the proper opening under any ambient condition.

If adjustment of the bimetal is needed, it must be made at ambient temperature. Do not attempt adjustments until engine has been shut down for at least one hour. Loosen the screw which secures the choke actuating arm to the linkage. Refer to Figure 4. Shortening the actuating arm makes the fuel mixture richer. Lengthening the arm makes the fuel mixture lean. For ambient temperatures above 85°F, the choke should be fully opened. For ambient temperatures below 25°F, the choke should be opened 1/4 inch with the solenoid not engaged. Tighten the screw that secures the choke actuating arm to the linkage.

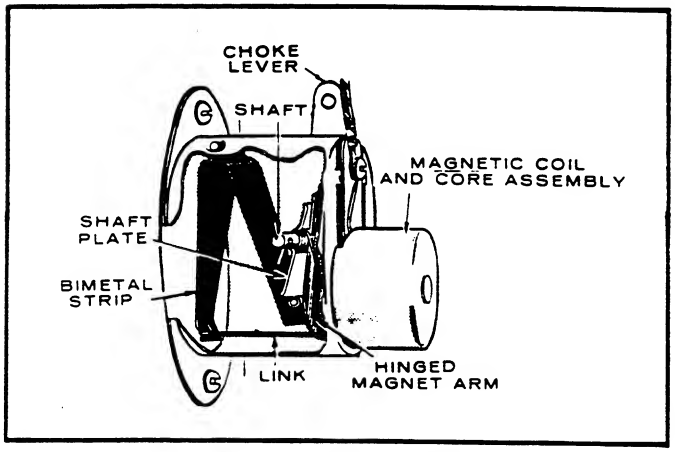


FIGURE 4. SISSON CHOKE

CARBURETOR ADJUSTMENT (GASOLINE)

The carburetor (Figure 5) has a high speed fuel main adjustment (needle A) and a fuel idle adjustment (needle B).

Adjust the carburetor to obtain the correct fuel-to-air mixture for smooth, efficient operation. The carburetor should be adjusted in two steps – first the load adjustment and then the idle adjustment.

IMPORTANT: *If the carburetor is completely out of adjustment so the engine will not run, open both needle valves 1 to 1-1/2 turns off their seats to permit starting. Do not force the needle valves against their seats. This will bend the needle.*

Before adjusting the carburetor. be sure the ignition system is working properly and the governor is adjusted. Then allow the engine to warm up.

1. Apply a full load to the engine.
2. Carefully turn the main adjustment in until speed drops slightly below normal. Then turn needle out until speed returns to normal.
3. With no load, turn the idle adjustment out until the engine speed drops slightly below normal. Then turn the needle in until the engine speed returns to normal.

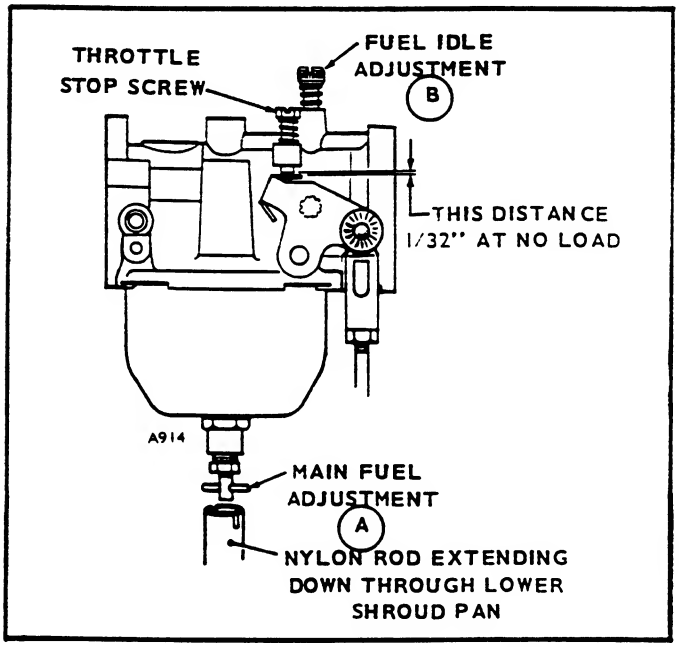


FIGURE 5. CARBURETOR ADJUSTMENTS

With the carburetor and governor adjusted, set the throttle stop screw, Figure 5, to allow 1/32 inch clearance to the stop pin with the engine operating at no load. This prevents excessive hunting when a large load is suddenly removed.

Float Level Adjustment: To check float level remove carburetor and take off the float bowl (unscrew large nut that holds bowl, Figure 5). The proper distance from the float to the carburetor body is 1/8 inch. The float tab should just touch the fuel inlet valve. Adjust by bending the tab on the float, Figure 6.

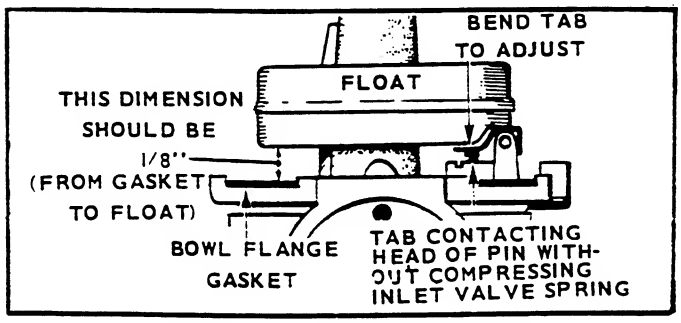


FIGURE 6. FLOAT ADJUSTMENT

Alternate Method: Use When There Is No Load Adjustment Possible.

1. Start the engine and allow it to warm up.
2. Push in on the governor mechanism to slow the unit down to about 400-500 rpm.
3. Set the idle adjustment screw for even operation (so the engine is firing on both cylinders and running smoothly).
4. Release the governor mechanism to allow the engine to accelerate. If the engine accelerates evenly and without a lag, the main adjustment is correct. If not, adjust the needle outward about 1/2 turn and again slow down the engine and release the mechanism. Continue until the engine accelerates evenly and without a time lag after releasing the governor.

FUEL PUMP

CAUTION *When checking fuel pump always direct fuel into a container. Do not spill fuel on ignition wires.*

A diaphragm type fuel pump is used (see Figure 7). If fuel does not reach the carburetor, check the fuel pump as follows:

1. Be sure there is fuel in tank.
2. Disconnect fuel line at carburetor.
3. Crank engine and see if fuel pumps through line.
4. Fuel pump is defective if line has no restrictions but no fuel pumps through.

Failure of the pump is usually due to a leaking diaphragm valve or valve gasket, a weak or broken spring, or wear in the drive linkage. Oil diluted with gasoline may indicate a faulty diaphragm. If the operator chooses to repair the pump rather than install a new one, the use of a complete repair kit is recommended.

NOTE: *Always return the hand priming lever all the way inward so that the priming lever does not prevent the normal operation of the pump.*

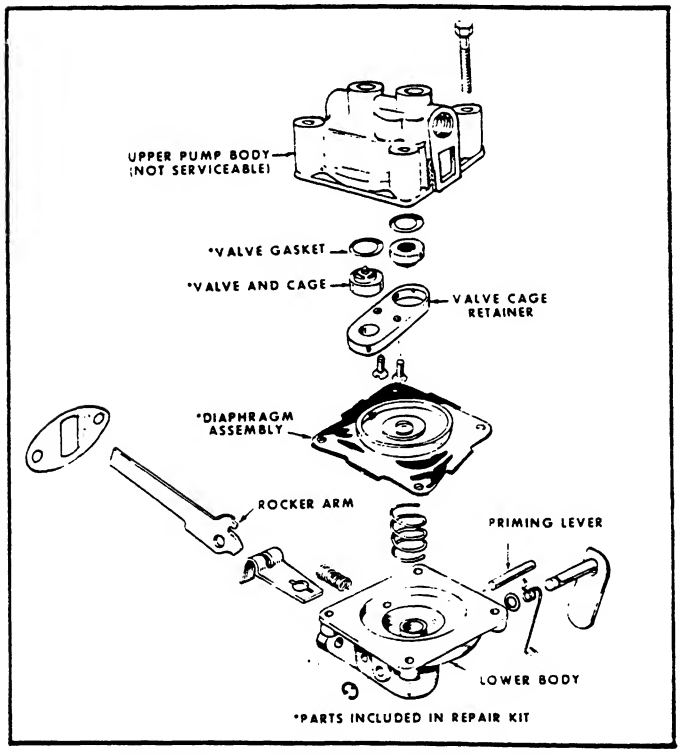


FIGURE 7. MECHANICAL FUEL PUMP

FUEL PUMP RECONDITIONING

1. Remove fuel lines and mounting screws holding pump to engine.
2. Make an indicating mark with a file across a point at the union of the fuel pump bolt and cover. This mark will assure proper reassembly. Remove assembly screws and remove upper pump body.
3. Turn pump body over and remove valve plate screw and washer. Remove valve retainer, valves, valve springs and valve gasket, noting their position. Discard valve springs, valves and valve retainer gasket.
4. Clean pump body thoroughly with solvent and a fine wire brush.
5. Holding the pump cover with the diaphragm surface up, place the new valve gasket into the cavity. Assemble the valve spring and valves in the cavity. Reassemble the valve retainer. Lock in position by inserting and tightening fuel pump valve retainer screw.
6. Place pump body assembly in a clean place and rebuild the lower diaphragm section.
7. Holding mounting bracket; press down on the diaphragm to compress spring under it, then turn bracket 90° to unhook diaphragm so it can be removed.
8. Clean mounting bracket with a solvent and a fine wire brush.
9. Replace the diaphragm operating spring, grand new spring in casting, position diaphragm and press down on diaphragm to compress spring and turn 90° to reconnect diaphragm.
10. Hold bracket, then place the pump cover on it (make sure that indicating marks are in line) and insert the four screws. DO NOT TIGHTEN. With the hand on the mounting bracket only, push the pump lever to the limit of its travel and hold in this position while tightening the four screws. This is important to prevent stretching the diaphragm.
11. Mount the fuel pump on engine, using new mounting gaskets. Connect the fuel lines.

CARBURETOR, GASEOUS FUEL

The gaseous fuel carburetor (Figure 8) is similar to the gasoline carburetor in shape, but it differs in operation. The gaseous carburetor contains two major sections, the idle circuit and the load circuit. Fuel delivery depends on the demand created on the fuel inlet line. A small vacuum on the inlet line opens the fuel regulator, delivering fuel. For no-load operation, the idle needle controls the quantity of fuel allowed through the idle port. The throttle is almost closed, so the increased vacuum on the engine side of the carburetor draws fuel through the idle passage. When load increases, the flow of air through the carburetor draws fuel from the main port located at the venturi of the carburetor.

Gas Carburetor Adjustment:

Adjust the carburetor idle adjustment needle valve and then the load adjustment needle valve. Figure 8A.

NOTE: *If the carburetor is completely out of adjustment so the engine won't run, open the idle adjustment one or two turns: then crank the engine while opening the main adjustment, until the engine starts.*

Adjust the carburetor in the same manner as the gasoline carburetor. Usually the idle adjustment has little effect on operation, at higher engine speeds.

1. Adjust the load adjustment screw on the carburetor, depending upon the type of gas used. For 800 BTU gas turn to approximately six turns open. For 1,100 BTU gas turn to 3-1/2 turns open. For propane gas, turn to approximately three turns open. Turn the idle screw to two turns open. These settings are preliminary, to permit starting the engine.

   For starting an engine manually, the gas should have a BTU rating above 800 BTU per cubic foot. The temperature should be above 30°F (–1°C) to permit sufficient cranking speed to be developed. Too low a cranking speed prevents proper intake vacuum for starting. Load should be disconnected, or reduced to the minimum.
2. Allow the engine to thoroughly warm up. When operating temperature is reached, make final carburetor adjustments. Apply a full load and turn the carburetor load adjust screw in (clockwise) until the engine begins to lose speed from lack of fuel. Slowly back out the load adjust screw (counterclockwise) until the engine will carry the full load smoothly. Remove all load and adjust the idle screw in the same manner. Check the operation at various loads.

When operating on gas fuel of approximately 800 BTU rating, some loss in power output may be evident. However, full power should be developed if using a gas rated at 1,100 BTU or higher.

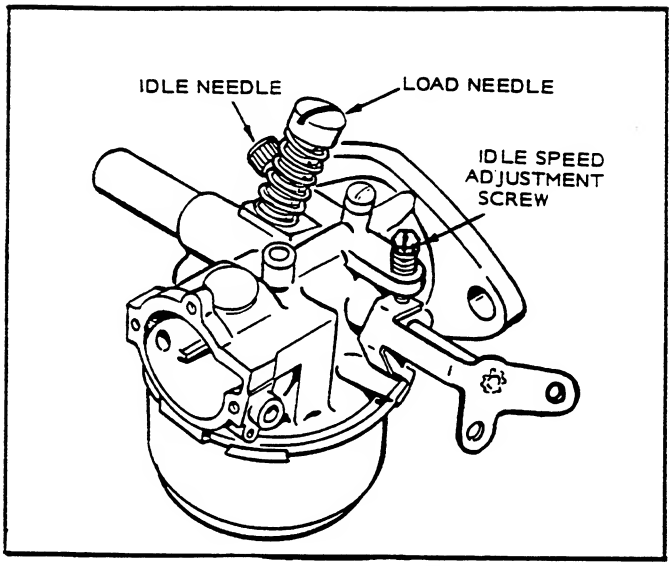


FIGURE 8. GAS CARBURETOR

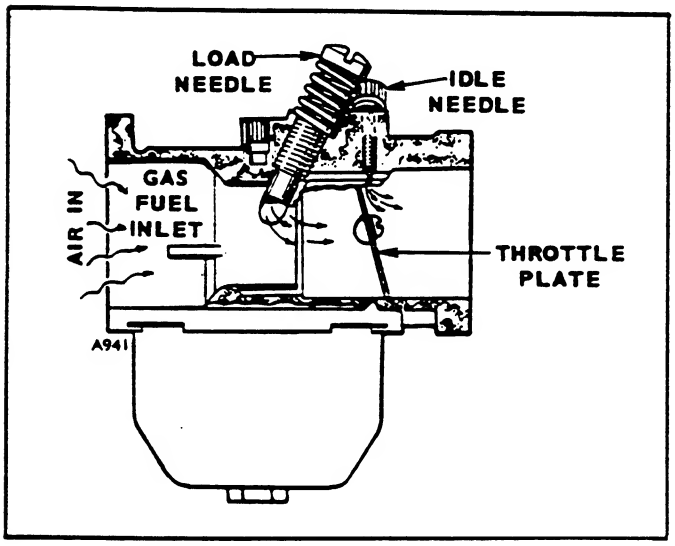


FIGURE 8A. GAS CARBURETOR (CUTAWAY)

SERVICE

For correction of problems traced to a gaseous fuel carburetor perform the following:

1. Clean or replace air cleaner.
2. Inspect hoses, replacing defective units, and securing all connections.
3. Clean dry fuel filter (if present).
4. Check regulator and carburetor for proper adjustments.

Removal and Disassembly:

1. Remove fuel hose and governor linkage.
2. Remove two carburetor mounting nuts and pull off carburetor.
3. Remove fuel bowl.
4. Remove idle needle and load needle.
5. Remove throttle screws and throttle. Pull out throttle shaft.

Repair and Assembly: Clean in a suitable carburetor cleaner and blow out the idle passage. Check the idle needle for wear or damage and the load needle for worn threads. For assembly, reverse the disassembly procedure.

CARBURETOR, COMBINATION GAS-GASOLINE

This carburetor operates on either gasoline or gaseous fuels. To switch operating fuels, make adjustments according to Carburetor Conversion Data Table. The combination carburetor consists of both the gasoline and gaseous fuel carburetors on a single casting. Refer to the gasoline and gaseous fuel carburetors for descriptions of operation. See Figure 8B.

GASEOUS FUEL REGULATOR

The demand-type regulator opens upon a small vacuum from the carburetor. It supplies fuel on demand, and shuts off fuel flow when the engine is stopped, or when there is no demand.

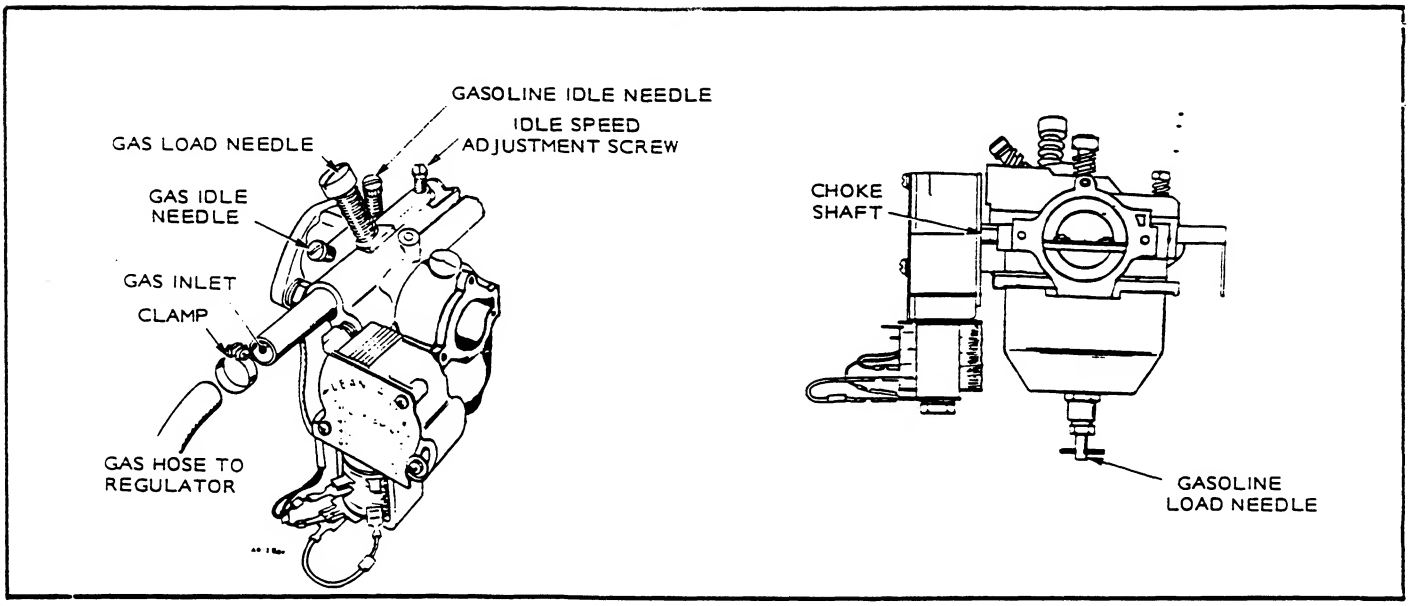


FIGURE 8B. GAS-GASOLINE CARBURETOR

CARBURETOR CONVERSION DATA

MODIFICATION	TO GASOLINE	TO GASEOUS FUEL
Gas supply valve	Close	Open
Carburetor float and needle valve	Replace if removed for gas	Remove if for extended operation on gas — reduces wear
Choke	Remove lock wire	Install lock wire
Spark plug gap	Set at .025"	Set at .025"
Gasoline fuel supply valve	Open	Close

The regulator is simply a diaphragm with linkage connecting it to a valve in the gas line. A small vacuum from the engine moves the diaphragm, opening the delivery valve.

Testing: Blow into the diaphragm vent hole on the regulator cover; this should open the valve. An audible hiss indicates that the regulator is opening.

A water manometer (Figure 8C) is the standard tool for testing regulator inlet pressure, which must be within the limits specified for your regulator.

Gas Regulator (Garretson): The maximum allowable inlet pressure is 8 ounces; minimum 2 ounces. If gas line pressure is greater than 8 ounces, install a primary regulator to reduce the pressure. The regulator has an adjustment to control the maximum pressure at which the regulator shuts off when there is no demand. To obtain maximum regulator sensitivity, adjust it to just shut off at your line pressure when there is no demand. Adjust the regulator for shut off when there is no demand, to prevent gas leaks. The factory adjusted shut-off between 2 and 4 ounces. If gas line pressure is between 4 and 8 ounces, readjust the screw.

To adjust the regulator, the gas line should be connected and the outlet hose removed. Make a coarse adjustment by turning the adjusting screw inward until the hissing of escaping gas at the outlet stops. Install a water manometer on the inlet side of the regulator to make the fine adjustment. With the gas on, cover the regulator outlet for a few seconds and then open. If the regulator is leaking, the pressure shown on the manometer will drop slightly or waver, indicating that the valve is opening. Turn the screw inward slightly and

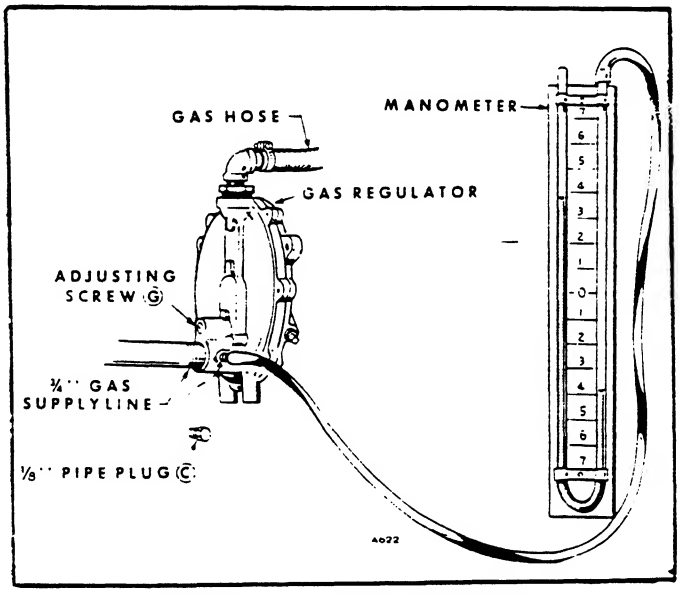


FIGURE 8C. WATER MANOMETER

repeat the test. Continue until the manometer holds steady as the outlet is closed for a few seconds and then opened.

If the regulator doesn't deliver fuel, check the inlet pressure. If pressure is over 5 psi (1 psi with optional solenoid valve) a primary regulator is required to reduce the inlet pressure. If the inlet pressure is within the required limits and the regulator won't deliver fuel or leaks, disassemble it for repair.

To disassemble the regulator, carefully remove the cover and separate the diaphragm from the cover and body. A kit is available from ONAN to repair the regulator.

GOVERNOR SYSTEM

GOVERNOR ADJUSTMENT

Where engine speed is governor controlled, the governor is set at the factory to allow a nominal engine speed of 1875 rpm at no load operation. Proper governor adjustment is one of the most important factors in maintaining the power and speed desired from the engine.

Before making governor adjustment, run the engine about 15 minutes to reach normal operating temperature. It is difficult to determine if, after long usage, the governor spring has become fatigued. If, after properly making all other adjustments, the regulation is still erratic, install a new spring (Figure 9).

A tachometer for checking engine speed is required for accurate governor adjustment.

Check the governor arm, linkage, throttle shaft and lever for binding or excessive wear at connecting points. A binding condition at any point will cause the governor to act slowly and regulation will be poor. Excessive looseness will cause a hunting condition and regulation will be erratic. Work the arm back and forth several times by hand while the engine is idle. If either of these conditions exist, determine the cause and adjust or replace parts as needed.

PROCEDURE

1. Adjust the carburetor main jet for the best fuel mixture while operating the plant with a full rated load connected.
2. Adjust the carburetor idle needle with no load connected.

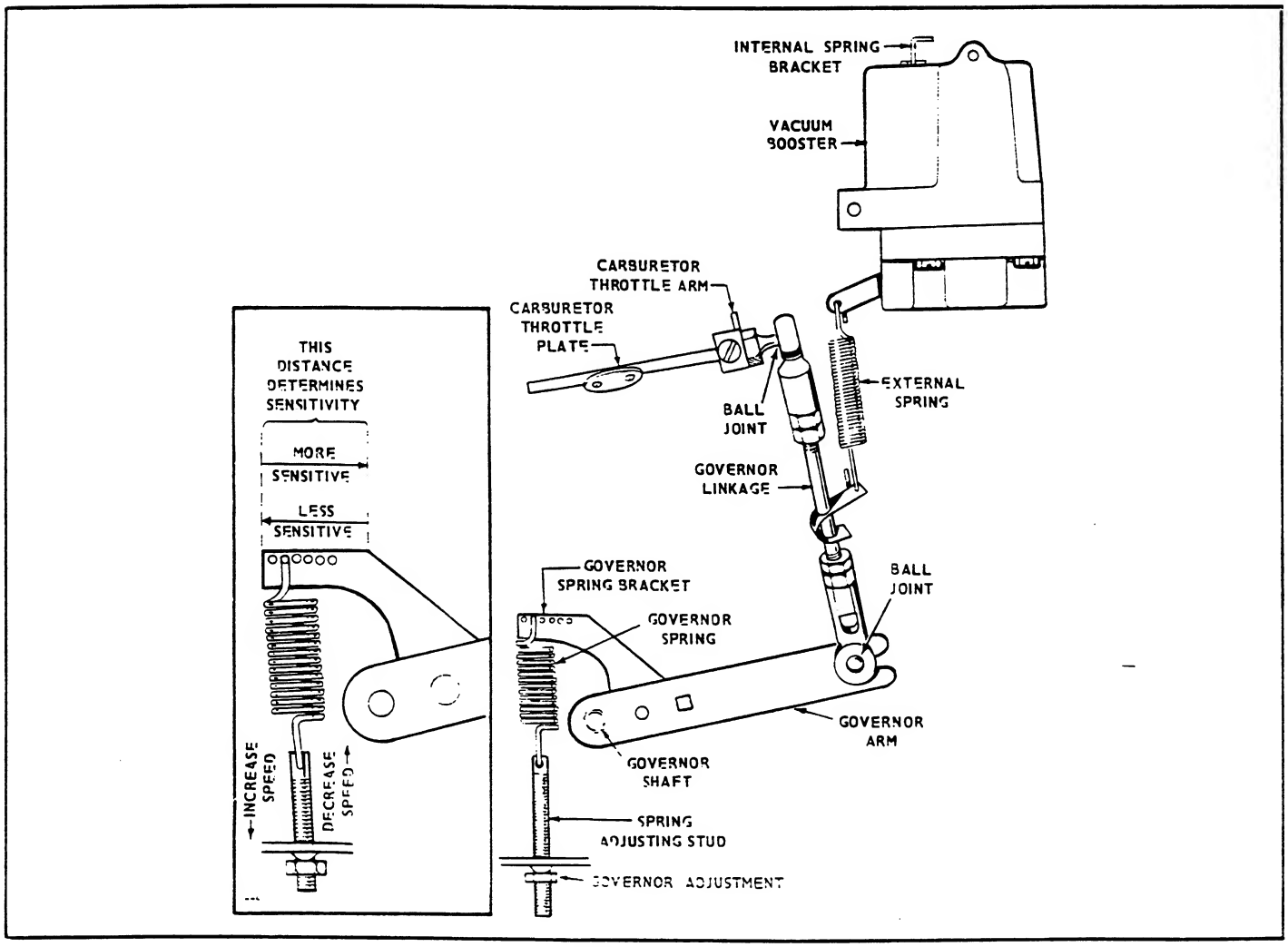


FIGURE 9. GOVERNOR ADJUSTMENTS

3. Adjust the length of the governor linkage.
4. Check the governor linkage and throttle shaft for binding or excessive looseness.
5. Adjust the governor spring tension for rated speed at no load operation (booster temporarily disconnected).
6. Adjust the governor sensitivity.
7. Recheck the speed adjustment.
8. Set the carburetor throttle stop screw.
9. Adjust booster (where used).

Linkage: The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle arm is adjusted by rotating the ball joint housing. Adjust the length so that with the engine stopped and tension on the governor spring, the stop on the carburetor throttle lever is 1/32 inch from the carburetor stop boss. This setting allows immediate control by the governor after starting and synchronizes travel of the governor arm and the throttle shaft.

Speed Adjustment: The speed at which the engine operates is determined by the tension applied to the governor spring. Increasing spring tension increases engine speed. Decreasing tension decreases engine speed. The no-load speed of the engine should be slightly higher than the speed requirements of the connected load.

For Example. If the connected load is to turn at 1800 rpm, set the no-load speed of the engine at 1875 rpm (approx.). Check the speed with a tachometer.

If a speed adjustment is needed, turn the speed adjusting nut in to increase the speed or out to decrease the speed (Figure 9).

SENSITIVITY ADJUSTMENT

The engine speed drop from no-load to full-load should be not less than 60 rpm. Check the engine speed with no-load connected and again after connecting full-load.

The sensitivity of the governor depends upon the position of the arm end of the governor spring. A series of holes in the governor arm provides for adjustment. To increase sensitivity, move the spring toward the governor shaft. To decrease sensitivity, move the spring toward the linkage end of the governor arm.

If the setting is too sensitive, a hunting condition (alternate increase and decrease in engine speed) will result. If the setting is not sensitive enough, the speed variation between no-load and full-load conditions will be too great. Therefore, the correct sensitivity will result in the most stable speed regulation without causing a surge condition.

Always recheck the speed adjustment after a sensitivity adjustment. Increasing sensitivity will cause a slight decrease in speed and will require a slight increase in the governor spring tension.

VACUUM BOOSTER ADJUSTMENT

After satisfactory performance under various loads is attained by governor adjustments without the vacuum booster, connect the booster. Connect the external spring to the bracket on the governor linkage. With the set operating at no-load, slide the bracket on the governor linkage to a position where there is no tension on the external spring.

Apply a full rated electrical load to the generator. The output voltage should stabilize at nearly the same reading at full-load as for no-load operation. The speed may remain about the same or increase when the load is applied, resulting in 1 or 2 cycles higher than the no-load frequency (1 cycle is equal to 60 rpm). If the rise in frequency is more than 2 cycles, lessen the internal spring tension. If there is a drop in frequency, increase the internal spring tension. To increase the tension, pull out the internal spring bracket and pin and move the pin to a different hole.

With the booster disconnected, a maximum drop of 5 cycles from no-load is normal. With the booster in operation, a maximum increase of 2 cycles from no-load to 2/3 load is normal. A drop of 1 cycle at 1/4 load is permissible, giving an overall spread of 3 cycles maximum.

SPEED CHART
FOR CHECKING GOVERNOR REGULATION

ALTERNATING CURRENT TYPE OF UNIT	FOR ALL 60 HERTZ UNITS	FOR ALL 50 HERTZ UNITS
Maximum No Load Speed		
RPM	1920	1620
Hertz (Current Frequency)	63	52
Minimum Full Load Speed Without Booster		
RPM	1710	1500
Hertz	59	50
Maximum Speed Drop from No Load Operation to Full Load Operation		
RPM	90	90
Hertz	3	3
Preferred Speed Regulation, No Load to Full Load Operation		
RPM	1830-1770	1590-1530
Hertz	61-59	53-51
Preferred Speed Spread		
RPM	60	60
Hertz	2	2

VOLTAGE CHART
FOR CHECKING GOVERNOR REGULATION

ALTERNATING CURRENT TYPE OF UNIT **NOTE**: Output rating is at UNITY power factor load.	120 VOLT 1 PHASE 2 WIRE OR 120/240 V 1 PHASE 3 WIRE	240 VOLT 1 PHASE 2 WIRE OR 240 VOLT 3 PHASE 3 WIRE
Maximum No Load Volts	126	252
Minimum Full Load Volts Without Booster	110	220
Maximum Voltage Drop from No Load Operation to Full Load Operation	16	32
Preferred Voltage Regulation, No Load to Full Load Operation	122-118	244-236
Preferred Voltage Spread	5	9

IGNITION SYSTEM

IGNITION EQUIPMENT

The battery ignition system timing procedures herein are for the standard pressure cooled and the optional or mobile Vacu-Flo cooled engine-generator sets. The timing point for all battery ignition models is at 22° before top center (BDC).

The magneto ignition system timing procedures herein are for the contractors model generator sets with the electric starter and an automatic spark advance mechanism. The timing point for magneto ignition models is 3° after top center (ATC) with the engine stopped and 22°BTC with the engine running at over 1500rpm.

The breaker point removal and gapping procedure is the same for both the battery and the magneto ignition systems.

BREAKER POINTS

Replace burned or faulty points. If only slightly burned, dress smooth with file or fine stone. Measure gap with thickness gauge. Set point gap at .020 inch.

Breaker Point Removal and Gapping:

1. Remove the cover of the breaker box, Figure 10.
2. Remove the spark plugs so the engine is easily rotated by hand.
3. Remove the breaker point mounting screws and replace the points with a new set. Do not completely tighten the breaker point mounting screws at this time.
4. Rotate the engine clockwise by hand until the mark on the flywheel and the TC mark on the gear cover align (Figure 11).
5. Turn the point adjusting cam screw (B) until the point gap is .020" and tighten mounting screws (A) as shown in Figure 10.
6. Turn flywheel to the left past the timing marks. Now turn to the right. Points should separate when flywheel TC mark aligns with the correct degree mark. If not, it is necessary to set the ignition timing.
7. Replace spark plugs.

TIMING STANDARD GENERATOR SETS

The standard pressure cooled engine timing mark is observed by looking through the flywheel fan to the timing marks on the gear cover, Figure 11. Engine timing is set at 22° BTC (before top center) and should be maintained for best engine performance. Always check timing after replacing ignition points or if noticing poor engine performance. Proceed as follows:

Timing Procedure – Engine Not Running:

1. Connect a continuity test lamp set across the ignition breaker points. Touch one test prod to the breaker box terminal to which the coil lead is connected and touch the other test prod to a good ground on the engine.
2. Turn crankshaft against rotation (counterclockwise) until the points close. Then slowly turn the crankshaft with rotation (clockwise).
3. The lamp should go out just as the points break which is the time at which ignition occurs (22° BTC).

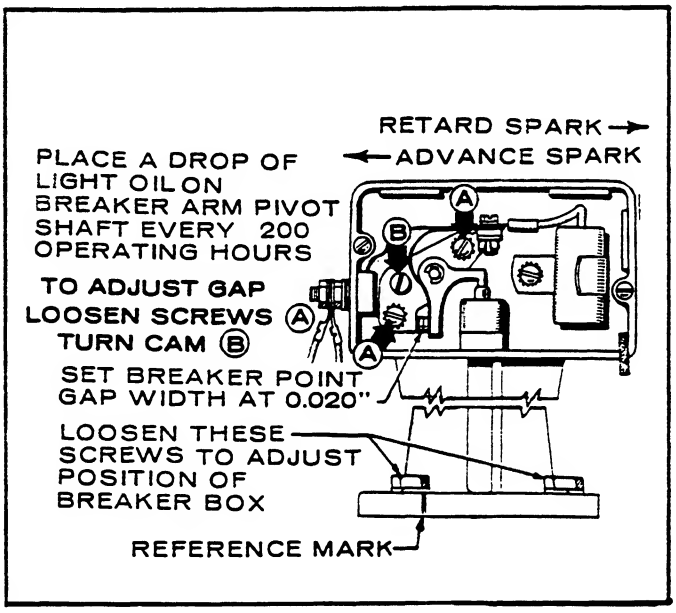


FIGURE 10. BREAKER POINTS

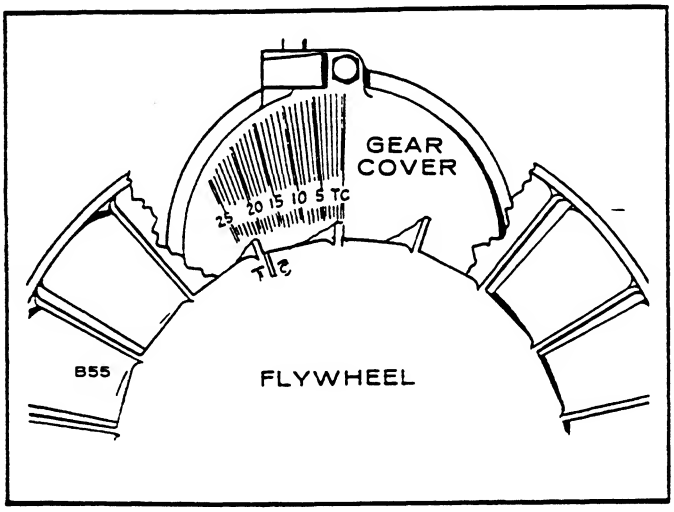


FIGURE 11. TIMING (PRESSURE COOLED)

Timing Procedure – Engine Running:

1. To accurately check the ignition timing, use a timing light when engine is running. Connect the timing light according to its manufacturer's instructions. Either spark plug can be used as they fire simultaneously.
2. Observe timing mark through flywheel fan.
3. Start the engine and check the timing. The mark on the flywheel should line up with the 22°BTC mark on the cover.
4. If timing needs adjustment, loosen the mounting screws on breaker box and move left to advance or right to retard the timing.
5. Start engine to be sure mark on flywheel lines up with 22° mark on cover.
6. Tighten all screws, replace timing plug.

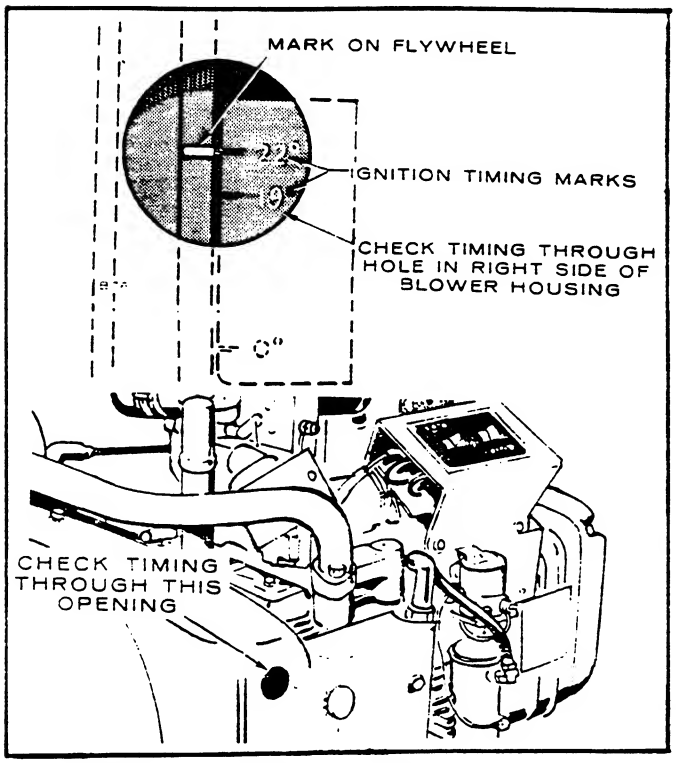


FIGURE 12. TIMING ACCESS HOLE (VACU-FLO)

TIMING VACU-FLO EQUIPPED GENERATOR SETS

Mobile and other Vacu-Flo equipped engine timing marks are observed through a plugged hole in the engine shroud, Figure 12.

Timing Procedure – Engine Not Running:

1. Connect a continuity test lamp set across ignition breaker points. Touch one test prod to the breaker box terminal to which the coil lead is connected and touch the other test prod to a good ground on engine.
2. Turn crankshaft against rotation (counterclockwise) until points close. Then slowly turn crankshaft with rotation (clockwise).
3. The lamp should go out just as points break which is time at which ignition occurs (22° BTC).

Timing Procedure – Engine Running:

1. To accurately check ignition timing, use a timing light when engine is running. Connect timing light according to its manufacturer's instructions. Either spark plug can be used as they fire simultaneously.
2. Remove the plug from timing hole, Figure 12.
3. Start engine and check timing. The mark on the flywheel should line up with the 22°BTC mark on the timing bracket.
4. If timing needs adjustment, loosen mounting screws on breaker box and move left to advance or right to retard the timing.
5. Start engine to be sure mark on flywheel lines up with 22° mark on the timing bracket.
6. Tighten all screws. replace timing plug.

TIMING CONTRACTOR MODEL GENERATOR SET

The contractors model NH Generator Set is equipped with electric start and magneto ignition. The magneto stator assembly is mounted on the gear cover and the flywheel must be removed to expose the magneto.

Spark Advance Mechanism (Contractor Model Only).

The spark advance mechanism (Figure 13)is located on the rear of the camshaft. It is operated by centrifugal force. As the engine speeds up, the weights rotate the cam and advance the spark. The cam returns to the retarded position as the engine speed is decreased. If the mechanism should become dirty or gummy, it would remain closed (retarded), causing the engine to lose power. If the mechanism remains open (advanced), the engine would possibly kick back on cranking. The cam advance must be snap acting. Should the engine fail to pick up speed or tend to alternately increase and decrease speed, the mechanism may require cleaning.

The spark advance mechanism can be reached for cleaning by either removing the cup shaped cover in the crankcase rear camshaft opening to expose the mechanism or by removing the camshaft from the engine. Do not indent the cup shaped cover as it will interfere with the weight mechanism.

Checking Advance Mechanism

1. The timing marks will be visible through the flywheel.
2. Connect timing light to spark plug.
3. Start engine and run at 3600 rpm.
4. View the timing marks, using a timing light. The "TC" flywheel mark should align with the TC mark on gear cover.
5. While watching the timing marks with the timing light, slow the engine to below 800 rpm. If the "TC" mark on the flywheel disappears and then reappears when the engine is brought back to speed, the mechanism is operating properly.
6. If the ignition advance mechanism DOES NOT REACT as described in step 5. remove, clean

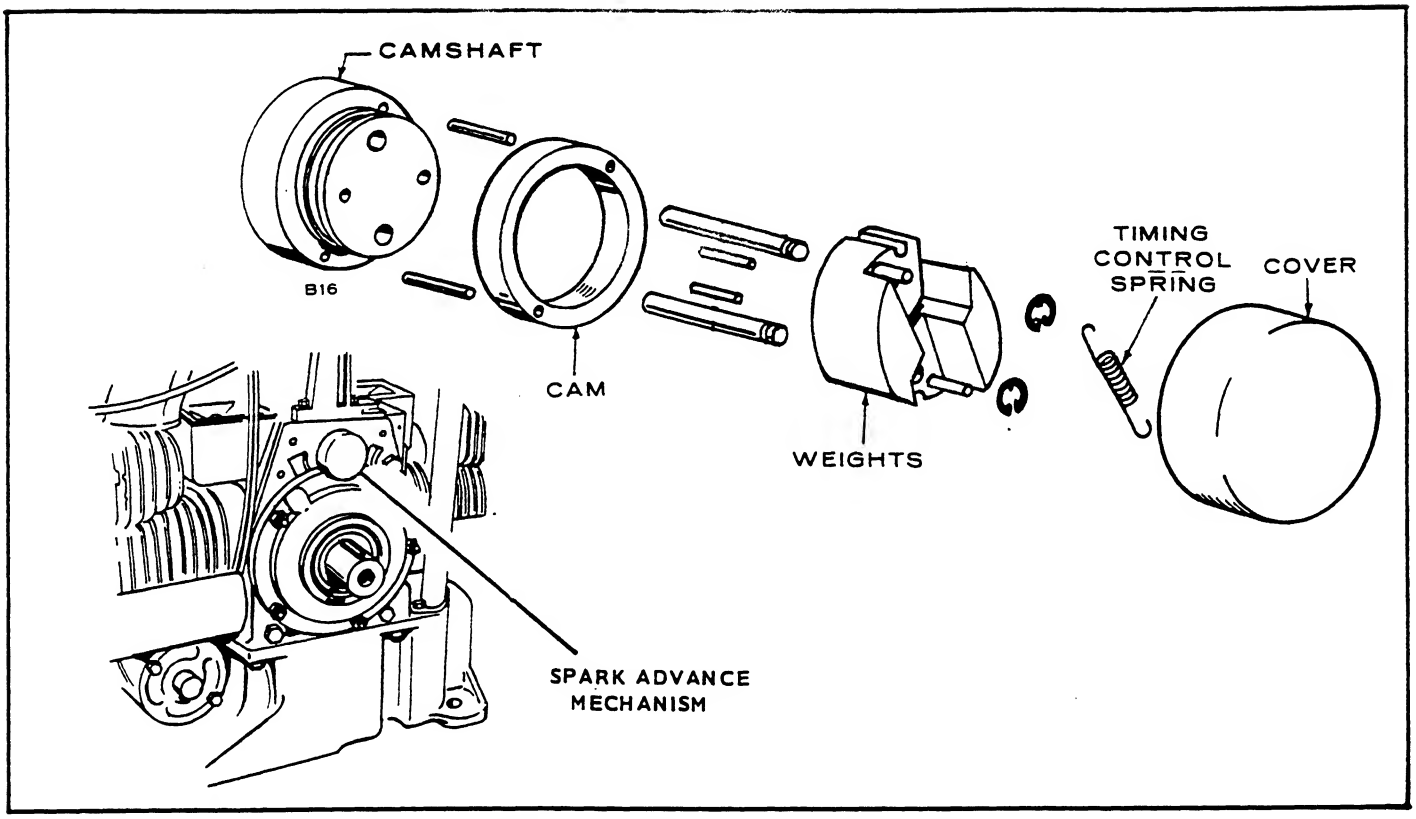


FIGURE 13. SPARK ADVANCE MECHANISM

and/or replace as necessary.

7. Replace the cover.

Timing Procedure, Set Running:

1. Install an automotive timing light on either of the spark plug leads.
2. Run the engine at rated speed and check timing with the light. If timing is incorrect, loosen the breaker plate mounting screws and correct it by moving the plate. Moving the plate left advances the timing moving it right retards the timing. Spark advance with engine running at 1800 rpm is 22° BTC. Tighten the plate and recheck the timing point.
3. Readjust the timing if necessary, tighten the breaker plate and then recheck the ignition point gap.

Timing Procedure, Set Stopped:

1. Remove the breaker box cover. If the ignition timing is off, attain the approximate setting (see Breaker Points). Install a continuity test lamp across the breaker points so the lamp lights when the points are closed.
2. Rotate the flywheel clockwise until the TC mark on the flywheel approaches the timing indicator (Figure 11). Then slowly rotate the flywheel clockwise until the light goes out, indicating that the points have opened. This is the ignition point. If the timing is correct, ignition occurs at 3°ATC.
3. If ignition timing isn't correct, align the 3°ATC mark and the timing pointer, then loosen the breaker plate capscrews and rotate the plate so the light goes out. Rotating clockwise advances the timing, counterclockwise retards it.
4. Tighten the plate and recheck the timing (Step 2). If timing is not correct, readjust the plate.

BATTERY IGNITION COIL

To test primary and secondary windings within the ignition coil (Figure 14) proceed as follows:

1. Use Simpson 260 VOM or equivalent.
2. Place black lead on ground (–) terminal of coil and red lead to positive (+) terminal. Primary resistance should read 4.30 (±10%) ohms @ 70°F.
3. Change resistance setting on ohmmeter. Place ohmmeter leads inside of spark plug cable holes (Figure 23). Secondary resistance should read 14,000 (±10%) ohms @ 70°F.
4. If any of the above conditions are not met, replace coil. Refer to parts catalog for correct part number.

MAGNETO IGNITION COIL

Test information for magneto ignition systems is given in Service Bulletins - Engine 11 and 12.

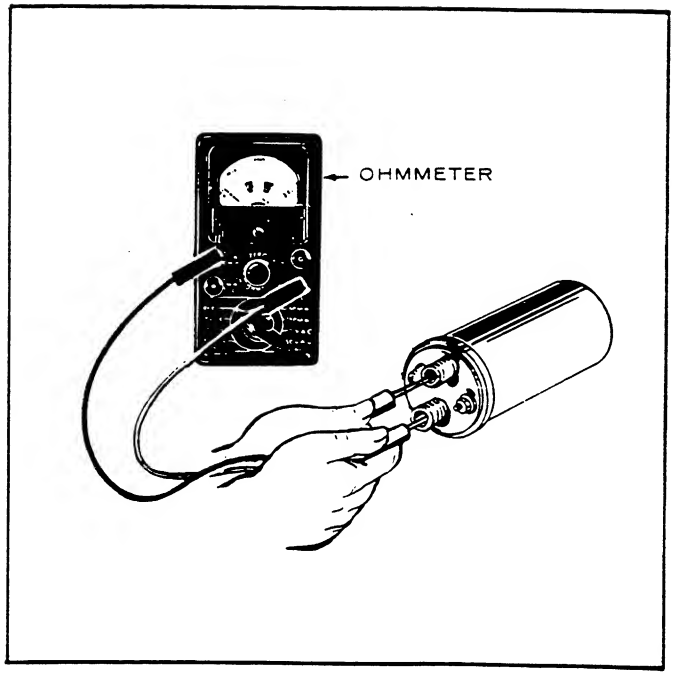
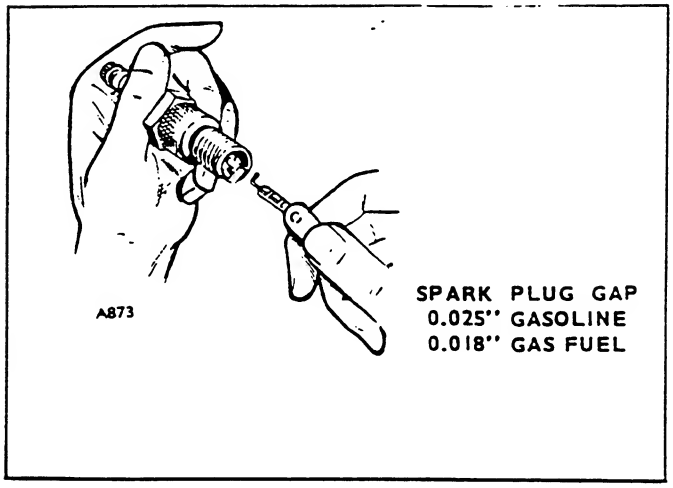


FIGURE 14. COIL TEST

SPARK PLUGS

Remove both spark plugs and install new ones every 100 hours. Use Champion N-6 or equivalent. Check to be sure spark plug gap is set at .025".



OIL SYSTEM

The NH engine (Figure 15) has pressure lubrication to all working parts. The oil system includes:

- Oil intake cup
- Gear type oil pump
- Oil pressure gauge
- Full flow oil filter
- Oil passages to deliver oil throughout the engine

The oil pump is located on the front surface of the crankcase and is driven by the crank gear. The inlet pipe and screen assembly is attached directly to the pump body. A discharge passage in the cover of the pump registers with a drilled passage in the crankcase. All of the oil from the pump flows through this passage to the oil filter and is then returned to the galleries in the block. Parallel passages distribute oil to the front main bearing, rear main bearing and pressure control bypass valve.

Circumferential grooves in the main bearings supply oil to the connecting rod bearings through drilled passages from each main journal.

A drilled passage connects the front main bearing oil supply to the front camshaft bearing. The flyball governor is lubricated by a drilled passage in the front camshaft journal.

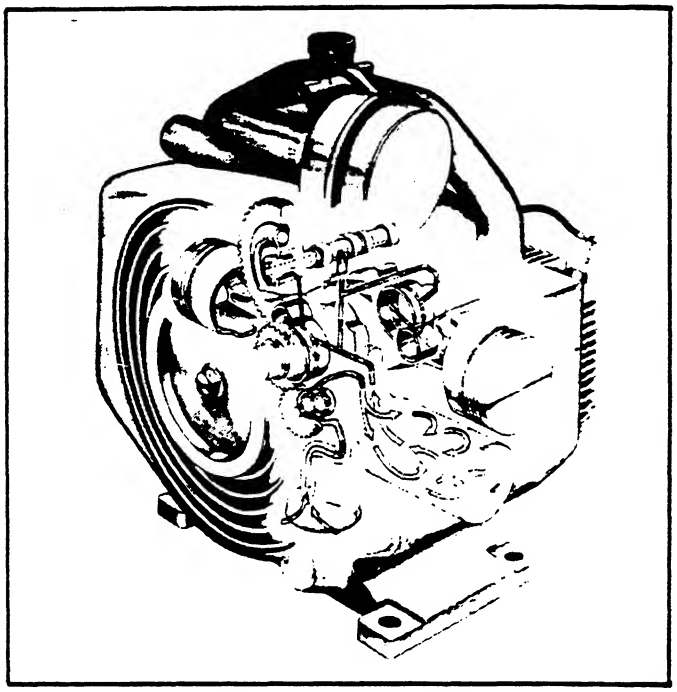


FIGURE 15. OIL FLOW

The oil overflow from the bypass valve furnishes lubrication to the camshaft drive gears.

Normal oil pressure should be 30 psi or higher when the engine is at operating temperature. If pressure drops below 30 psi at governed speed, inspect the oil system for faulty components.

CRANKCASE BREATHER (Ball Check Valve)

The engine is equipped with a ball check valve for maintaining crankcase vacuum. No maintenance is generally required. Should the crankcase become pressurized, as evidenced by oil leaks at the seals or around the cap of the oil level indicator, clean the baffle in suitable solvent (Figure 16).

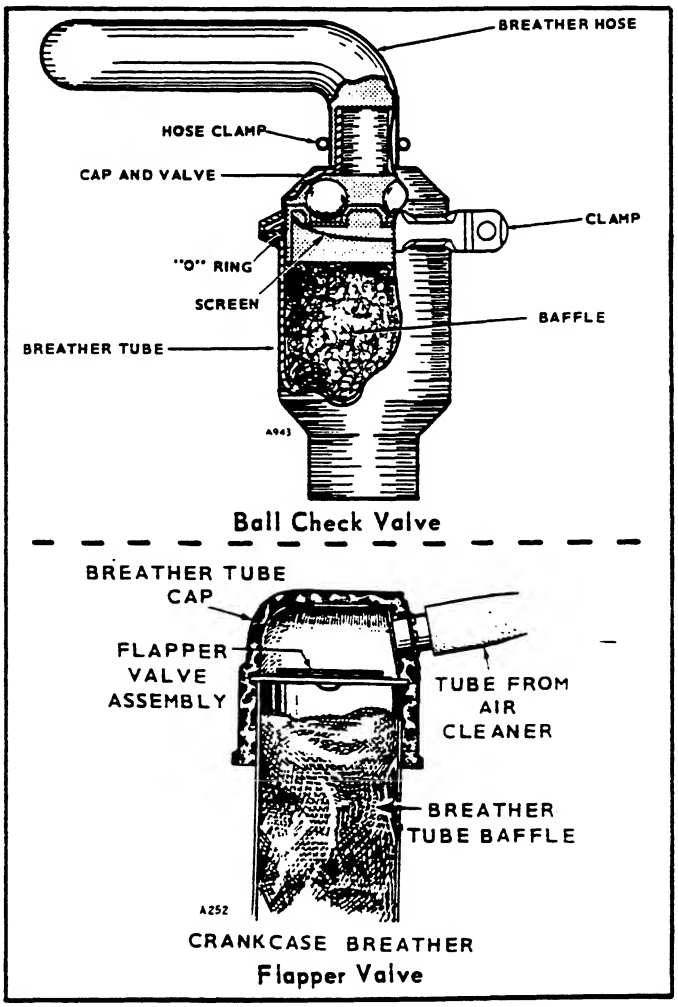


FIGURE 16. CRANKCASE BREATHERS

CRANKCASE BREATHER (Flapper Valve)

Lift off rubber breather cap. Carefully pry valve from cap. Otherwise press hard with both of your thumbs on top of cap and fingers below to release valve from rubber cap. Wash this fabric flapper type check valve in a suitable solvent. Dry and install. Position perforated disc toward engine.

OIL FILTER

Change the crankcase oil filter every 200 hours. Re-

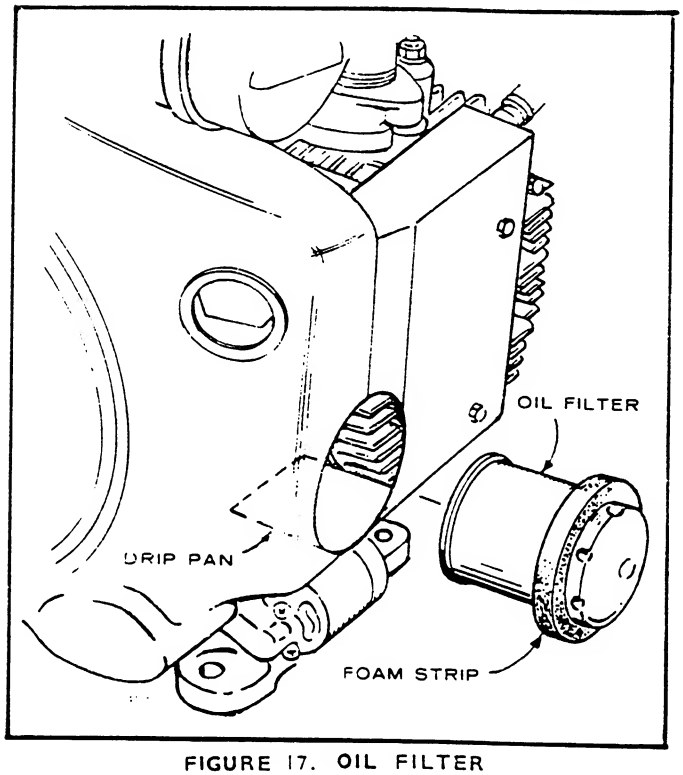


FIGURE 17. OIL FILTER

move the filter by turning counterclockwise, using a filter wrench. Add the foam strip air seal provided with the filter to prevent air loss around the filter. It is advisable to wipe dry the drip pan located below the filter. Install the filter finger tight plus 1/4 to 1/2 turn. If oil becomes so dirty that the markings on the oil level indicator cannot be seen, change the filter and shorten the filter service periods (Figure 17).

OIL PRESSURE GAUGE

Located in the upper right hand corner of the engine shroud. Before replacing, check for clogged oil passage behind the gauge. Remove it with a wrench and replace with a new gauge if faulty.

CRANKCASE OIL

The oil capacity is 4 U.S. quarts (4-1/2 with filter). Fill to the "FULL" mark on the oil level indicator. Use a good quality, detergent oil with the API (American Petroleum Institute) designation SE or SE/CC. Do not use an oil with the designation CD unless it is also designated SE and the oil manufacturer certifies it will perform satisfactorily in gasoline engines. Ambient temperatures must be the factor for determining the proper SAE oil weight.

IMPORTANT: *Use low ash content oils .03-.85 percent by weight with natural gas or propane fueled engines.*

OIL PRESSURE RELIEF VALVE ADJUSTMENT

Engine oil pressure is adjusted by means of the slotted stud and locknut located near the breather tube. See Figure 18. Oil pressure readings, when the engine is thoroughly warmed up, should be between 30 and 35 lbs. To increase oil pressure, loosen the locknut and turn the stud inward. To decrease oil pressure, loosen the locknut and turn the stud outward. Be sure to tighten the locknut securely after making an adjustment. The spring and plunger can be removed and cleaned.

Low oil pressure may indicate worn main or connecting rod bearings, improper clearance at these points, a weak or broken bypass spring, an improperly adjusted bypass or a defective gauge. Check the oil pressure gauge before making any other test; it may be defective.

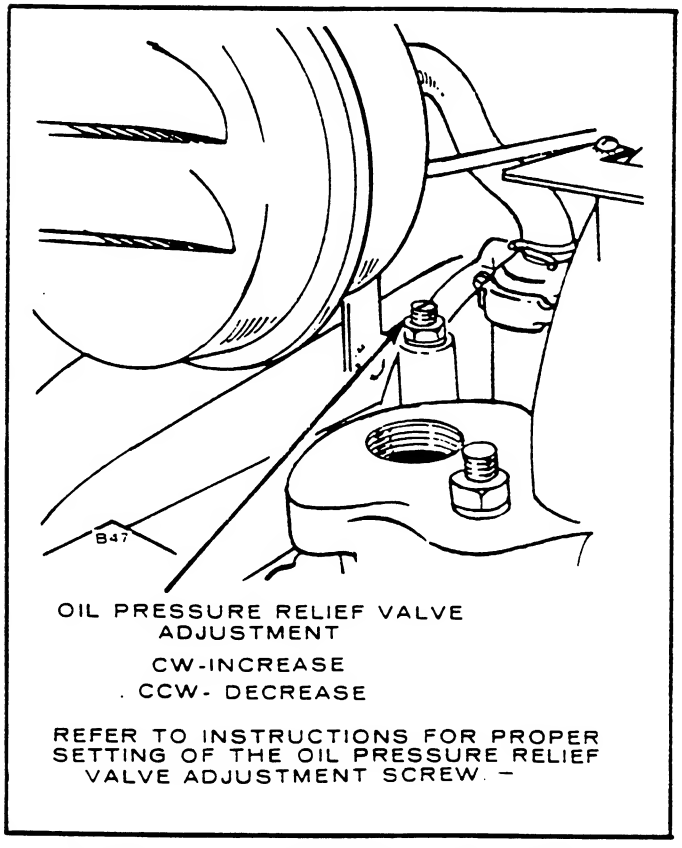


FIGURE 18. OIL PRESSURE RELIEF VALVE

NOTE: *All engines beginning with Spec D have a fixed oil bypass (relief valve) pressure.*

ENGINE DISASSEMBLY

GENERAL

If engine disassembly is necessary observe the following order (i.e. generator, flywheel, gear cover, etc.). As the disassembly process progresses the order of disassembly may be altered to fit the situation. Engine assembly procedure is the reverse of the disassembly procedure. Any special assembly instructions for a particular group are included in the applicable section.

FLYWHEEL

To remove the flywheel, turn the flywheel mounting screw outward about two turns. Use a screwdriver behind the flywheel to take up the crankshaft end play. Then strike a sharp endwise blow on the head of the cap screw with a heavy soft-faced hammer to loosen. A suitable wheel puller (with claws or with bolts to agree with flywheel) should be used to pull the flywheel.

Do not drop the flywheel. A broken fin will destroy the balance. Always use a steel key for mounting the flywheel.

GOVERNOR CUP

With the gear cover removed, the governor cup can be taken off after removing the snap ring from the camshaft center pin. Catch the flyballs while sliding the cup off. See Figure 20.

Replace any flyball that is grooved or has a flat spot. If the arms of the ball spacer are worn or otherwise damaged, remove the spacer by splitting with a chisel. Replace the spacer with a new one. The governor cup must spin freely on the camshaft center pin without excessive looseness or wobble. If the race surface of the cup is grooved or rough, replace it with a new one.

When installing the governor cup, tilt the engine so the gear is up, put the flyballs in place and install the cup and snap ring on the center pin.

The camshaft center pin extends out 3/4" from the end of the camshaft. This distance provides an in and out travel distance of 7/32" for the governor cup, as illustrated. Hold the cup against the flyballs when measuring. If the distance is less (the engine may race, especially at no load), remove the center pin and press a new pin in only the required amount. Otherwise, grind off the hub of the cup as required. The camshaft center pin cannot be pulled outward nor removed without damage. If the center pin extends out too far, the cup will not hold the flyballs properly.

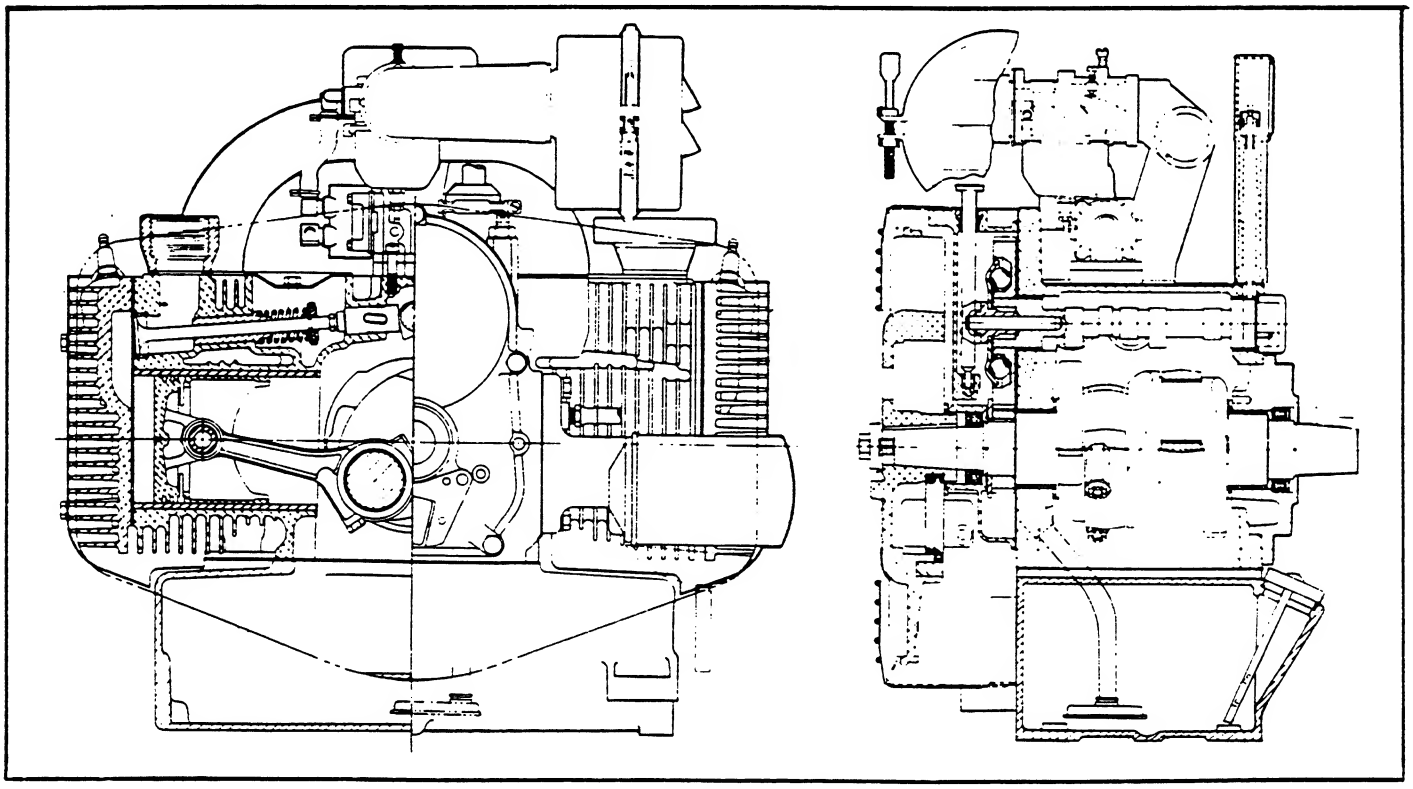


FIGURE 19. ENGINE ASSEMBLY

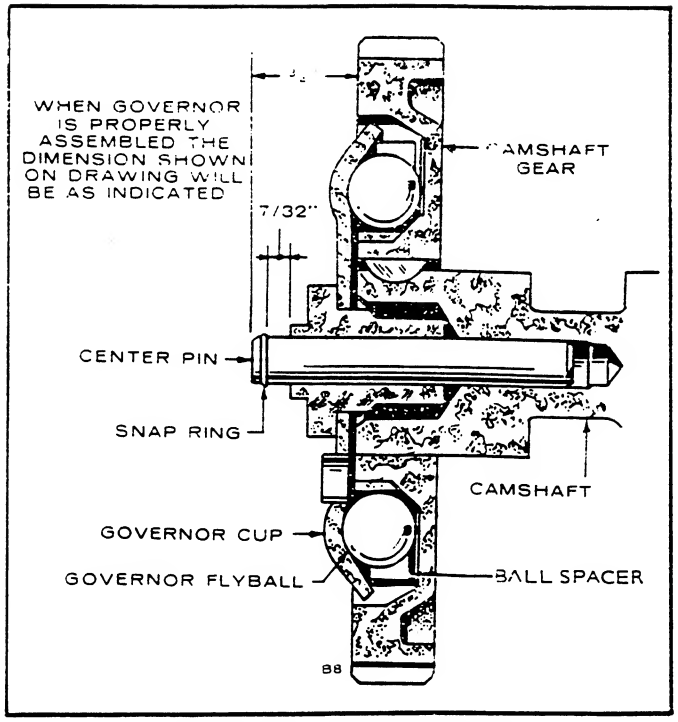


FIGURE 20. GOVERNOR CUP

GEAR COVER

After removing the flywheel key and mounting screws, tap the gear cover gently with a soft-faced hammer to loosen it.

CAUTION *When installing the gear cover, make sure that the pin in the gear cover engages the metal lined (smooth) hole in the governor cup.*

Turn the governor cup so that the metal lined hole is at the three o'clock position. The smooth side of the governor yoke must ride against the governor cup. Turn the governor arm and shaft clockwise as far as possible and hold in this position until the gear cover is installed flush against the crankcase. Be careful not to damage the gear cover oil seal. Adjust the roll (stop) pin to protrude to a point 3.4" from the cover mounting surface. See Figure 21.

TIMING GEARS

If replacement of either the crankshaft gear or the camshaft gear becomes necessary, install both gears new, never one only. Use a gear puller ring and gear puller to remove the crankshaft gear. Be sure to remove the snap ring first.

The camshaft gear is pressed on and keyed to the camshaft. The camshaft and gear must be removed as an assembly, after first removing the crankshaft gear lock ring and washer. Before removing the camshaft and gear assembly, remove the cylinder head and valve assemblies. Remove the operating plunger for the breaker points. Remove the fuel pump and tappets.

The camshaft may be pressed out of the gear by use of a hollow tool or pipe which will fit over the camshaft center pin. Do not press on the center pin or damage it in any way. The governor ball spacer is a press fit to the camshaft gear.

When pressing a camshaft gear onto the camshaft, be sure the gear is started straight and that the key is properly in place. When replacing the cam gear on units having automatic spark advance mechanism, remove the spark advance mechanism and put blocks beside the pins to avoid damage when pressing on cam gear. Install the governor cup assembly before installing the camshaft and gear in the engine.

Each timing gear is stamped with an O mark near the edge. The gear teeth must mesh so that these marks

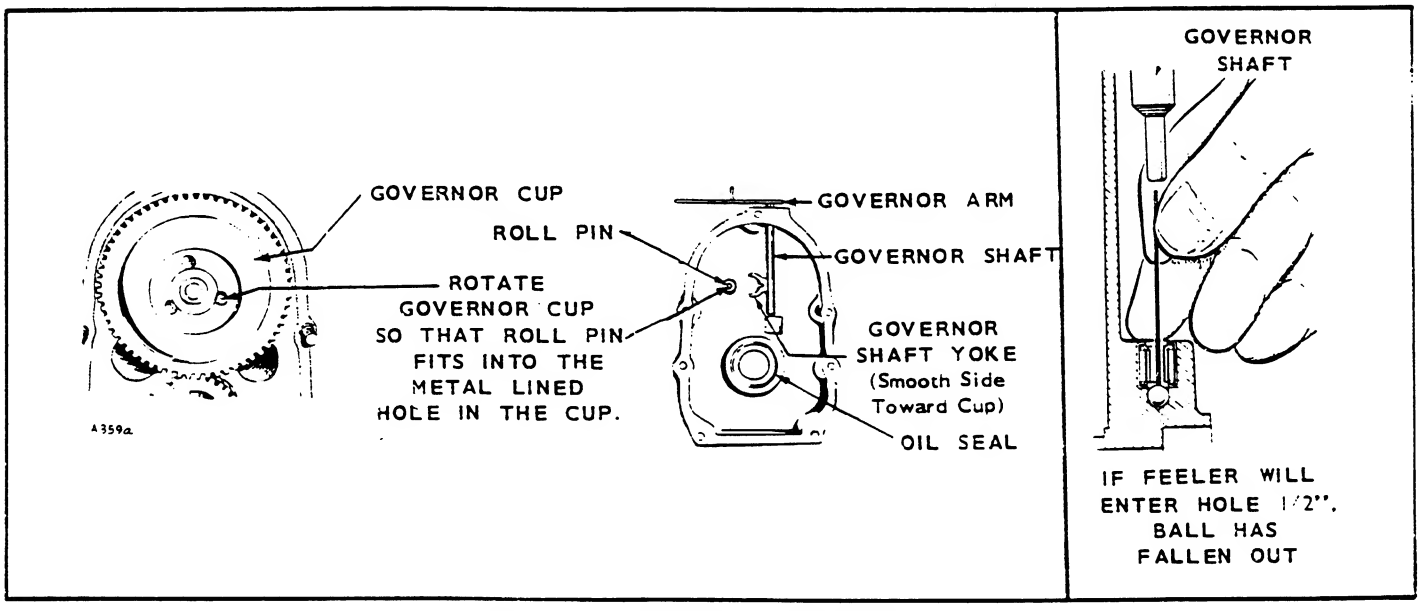


FIGURE 21. GEAR COVER ASSEMBLY

coincide exactly when the gears are installed in the engine. Be sure, when installing the camshaft gear and shaft assembly, that the thrust washer is properly in place behind the camshaft gear. Replace the camshaft retaining washer and lock ring to the crankshaft.

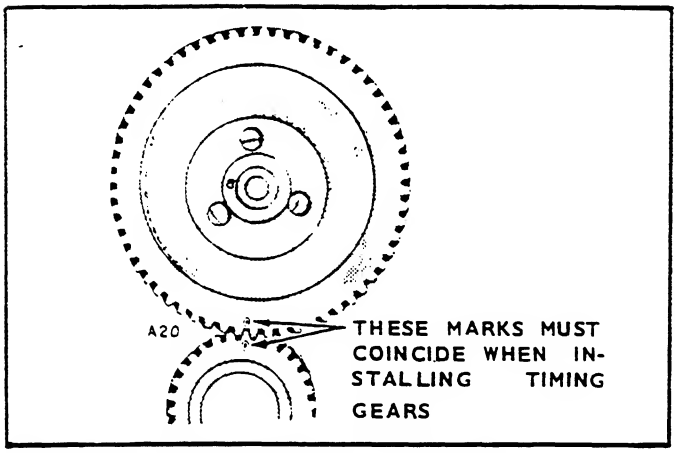


FIGURE 22. TIMING GEAR INSTALLATION

CYLINDER HEADS

The cylinder head bolts should be tightened in the order designated and to the torque specified at the time the engine is assembled or the cylinder head replaced. This should be at room temperature. At some later time, after the engine has been operated so it has reached normal hot temperature *and allowed to cool to room temperature,* the cylinder head bolts should be retorqued to the original specified torque. This retightening should be done before the engine has been run a total of fifty hours. See Figure 23 for the proper head bolt tightening sequence.

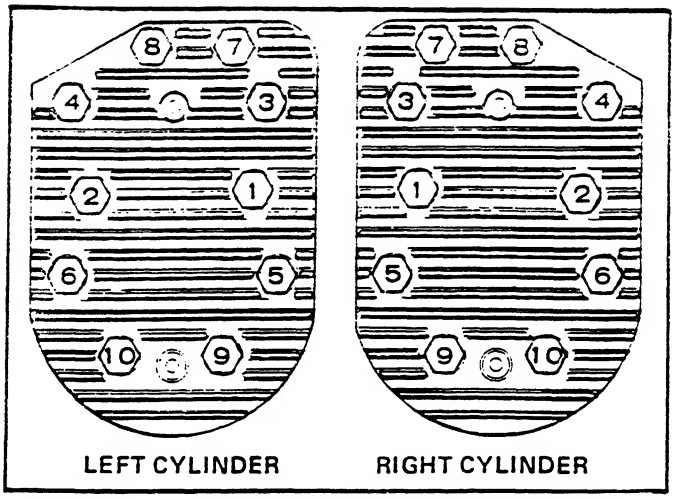


FIGURE 23. HEAD BOLT TIGHTENING SEQUENCE

NOTE: *Beginning Spec C, cylinder head flat washers are also used with the cylinder head nuts.*

VALVES

Properly seated valves are essential to good engine performance. The cylinder head is removable for valve servicing. Do not use a pry to loosen the cylinder head. Rap sharply on the edge with a soft-faced hammer, taking care not to break any cooling fins. A conventional type valve spring lifter may be used when removing the valve spring locks, which are of the split type. Clean all carbon deposits from the cylinder head, piston top, valves, guides, etc. If a valve face is burned or warped, or the stem worn, install a new valve.

Worn valve stem guides may be replaced from inside the valve chamber. A gasket is provided behind the intake valve guides only. The smaller diameter of the

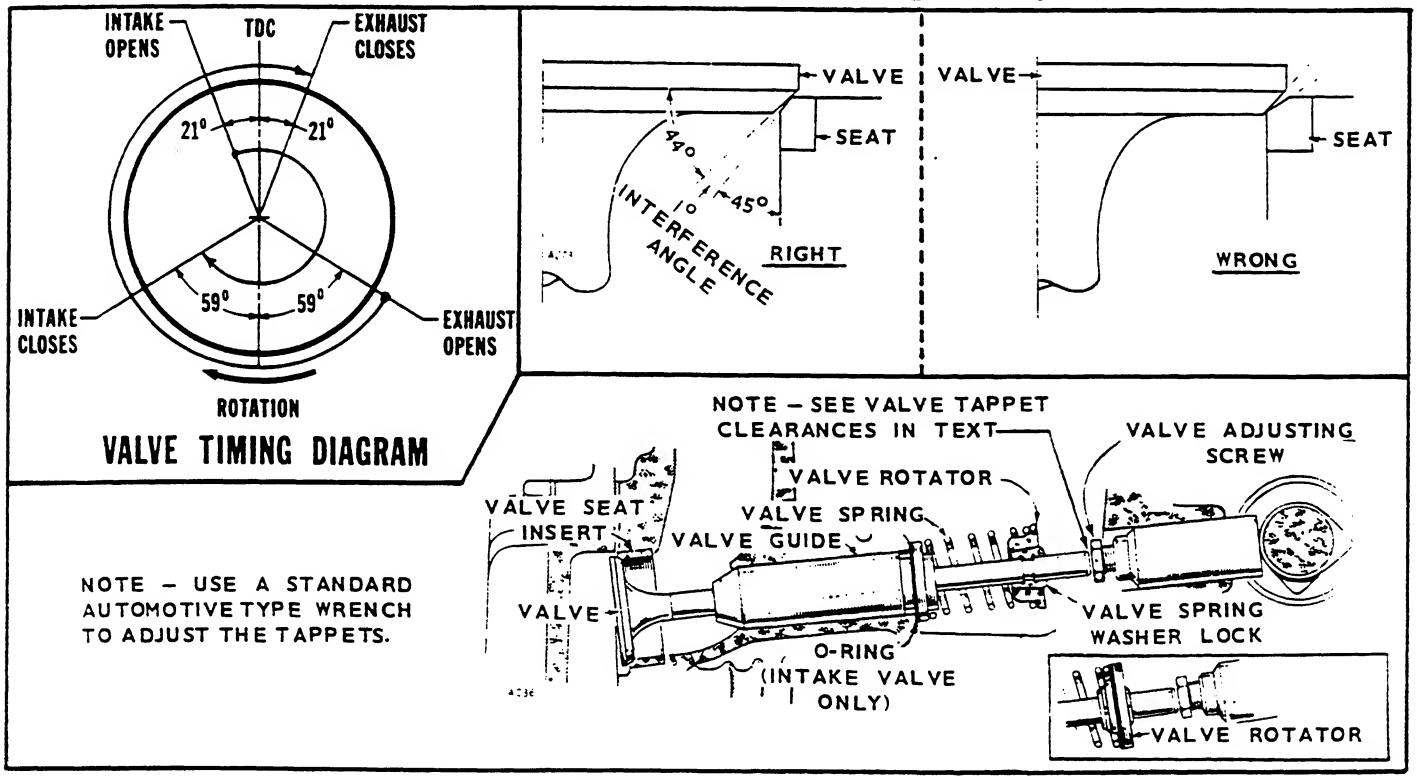


FIGURE 24. VALVES

tapered valve guides must face toward the valve head.

Tappets are also replaceable from the valve chamber after first removing the valve assemblies.

The valve *face* angle is 44°. The valve *seat* angle is 45°. This 1° interference angle results in a sharp seating surface between the valve and the top of the valve seat. The interference angle method of grinding valves minimizes face deposits and lengthens valve life (Figure 24).

The valves should not be hand lapped, if at all avoidable, since the sharp contact may be destroyed. This is especially important where stellite faced valves and seats are used. Valve faces should be finished in a machine to 44°. Valve seats should be ground with a 45° stone and the width of the seat band should be 1/32 to 3/32 of an inch wide. Grind only enough to assure proper seating.

Remove all grinding compound from engine parts and place each valve in its proper location. Check each valve for a tight seat, using an air pressure type testing tool. If such a tool is not available, make pencil marks at intervals across the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn against the seat.

Lightly oil the valve stems and reassemble all parts removed. Adjust the valve clearance.

The positive type valve rotators serve to prolong valve life and decrease valve repairs. Check the rotators periodically by removing the cylinder heads and cranking the engine. When functioning properly, the valve is rotated a fraction of a turn each time it opens. If rotators are faulty, install new ones.

TAPPET ADJUSTMENT

The engine is equipped with adjustable tappets. To make a valve adjustment, remove the valve covers. Crank the engine slowly by hand until the left hand intake valve, when facing the flywheel, opens and closes. Continue about 1/4 turn until the mark on the flywheel and the TC mark on the gear cover are in line. This should place the left hand piston in the necessary position to obtain correct valve adjustment.

Correct valve clearances are .003 for intake and .010 exhaust. For each valve, the gauge should just pass between the valve stem and valve tappet (Figure 25).

To correct the valve clearance, turn the adjusting screw as needed to obtain the right clearance. The screw is self-locking.

To adjust the valves on the right hand cylinder, crank the engine over one complete revolution and again line up the mark on the flywheel and the TC mark on the gear cover. Then follow the adjustment given for the valves of the left hand cylinder.

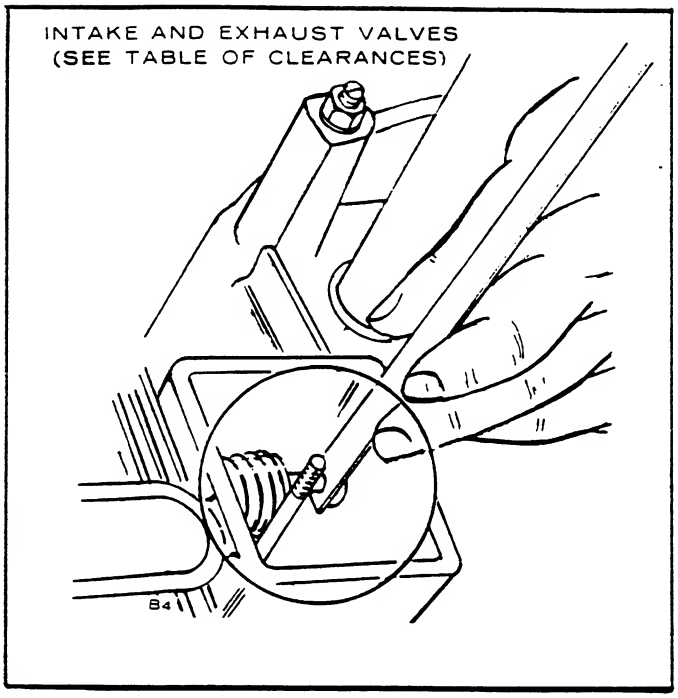


FIGURE 25. TAPPET ADJUSTMENT

EXHAUST PORT INSERTS (BEGIN SPEC C)

Inserts are located in each cylinder's exhaust port. If the manifold is removed, the inserts can be taken out or fall out if the block is turned upside down. Be sure to replace them before the manifold is reattached (Figure 26).

CAUTION *It's extremely important the inserts are in the exhaust ports. The ports have been machined and the inserts included at the factory to play an important function in exhaust heat transfer.*

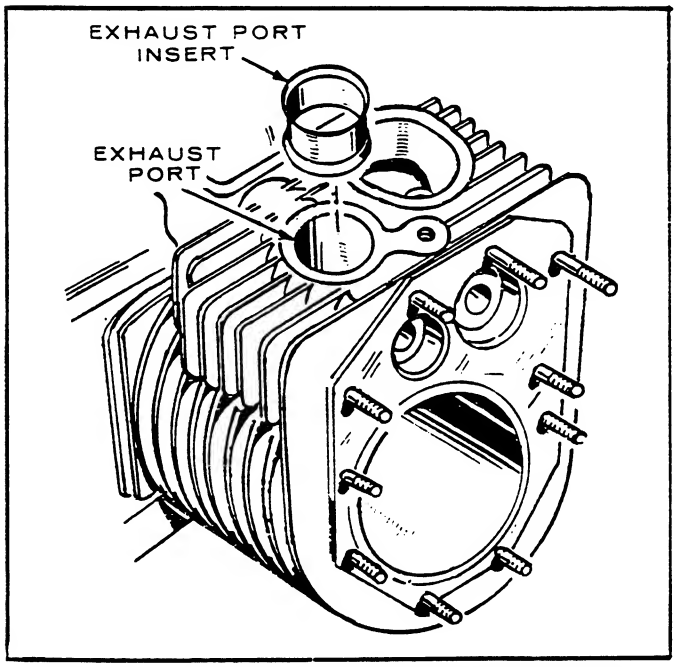


FIGURE 26. EXHAUST PORT INSERT (BEGIN SPEC C)

PISTONS AND RINGS

Whenever there is a noticeable wear ridge at the top of each cylinder, remove the ridge before removing the pistons. If not, the rings can catch the ridge when pushing out the pistons and cause a ring land fracture (Figure 27).

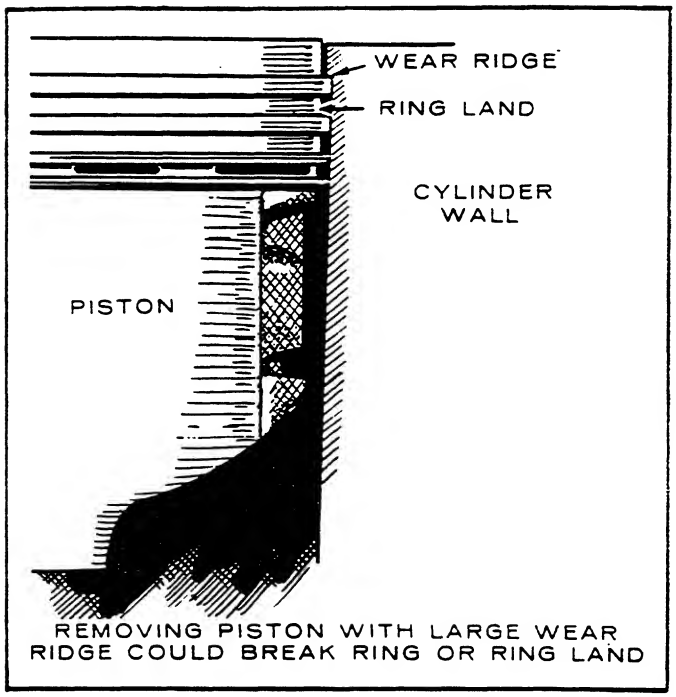


FIGURE 27. WEAR RIDGE ON CYLINDER WALL

To remove the piston and connecting rod assemblies, turn the crankshaft until a piston is at the bottom of the stroke. Remove the nuts from the connecting rod bolts. Lift the rod bearing cap from the rod and push the rod and piston assembly out the top of the cylinder with the handle end of a hammer. Be careful not to scratch the crankpin or the cylinder wall when removing these parts.

NOTE: *Keep the connecting rod bearing caps and bearings with their respective rods.*

The pistons are fitted with two compression rings and one oil control ring with an expander. Remove these rings from the piston using a piston ring spreader.

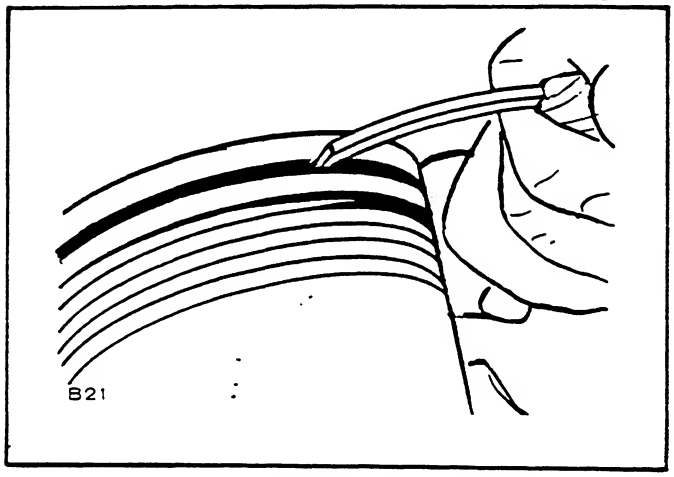


FIGURE 28. CLEANING RING GROOVES

Clean the piston ring grooves with a groove cleaner or the end of a broken ring filed to a sharp point (see Figure 28). All passages should be cleaned with a non-caustic solvent. Clean the rod bore and the back of the connecting rod bearings thoroughly.

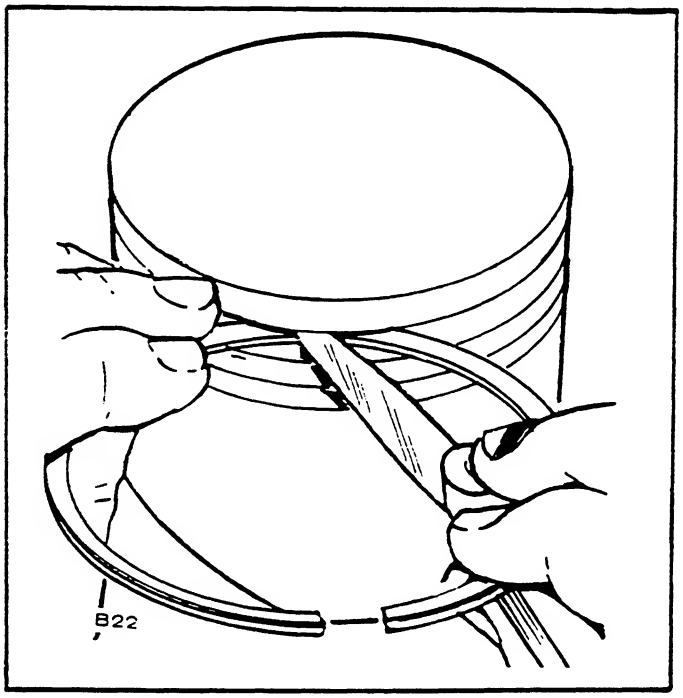


FIGURE 29. RING LAND INSPECTION

Mark each piston to make sure the rod will be assembled on the piston from which it was removed. Remove the piston pin retainer from each side and push the pin out.

Inspect the pistons for fractures at the ring lands, skirts and pin bosses. Check for wear at the ring land using new rings and a feeler gauge as shown in Figure 29. See the Table of Clearances for proper side clearance measurement.

Improper width rings or excessive ring side clearance can result in ring breakage. New rings in worn ring grooves don't have good cylinder wall contact (Figure 30).

Replace pistons showing signs of bad scoring or burring, excessive skirt clearance, wavy or worn ring lands, fractures or damage from detonation. Replace piston pins showing fractures, scored bores or bores out of round more than 0.002".

Use a new piston pin to check the pin bushing in the connecting rod for wear. The clearance should be as shown in the Table of Clearances.

Before installing new rings on the piston, check the

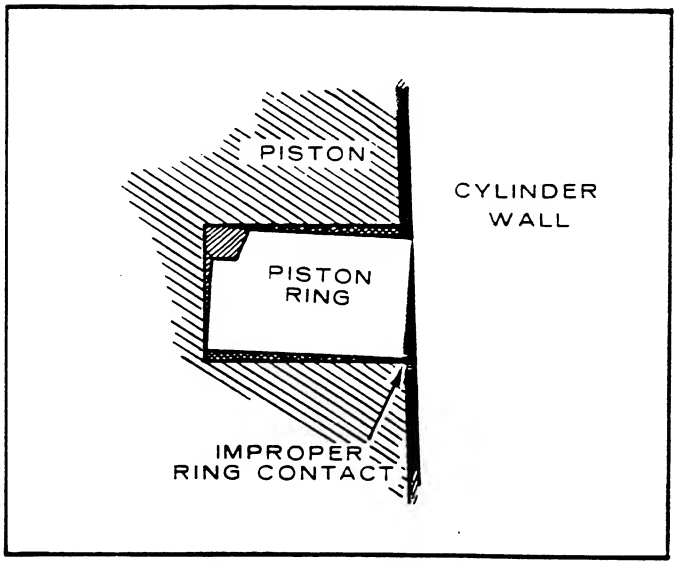


FIGURE 30. NEW RING IN WORN RING GROOVE

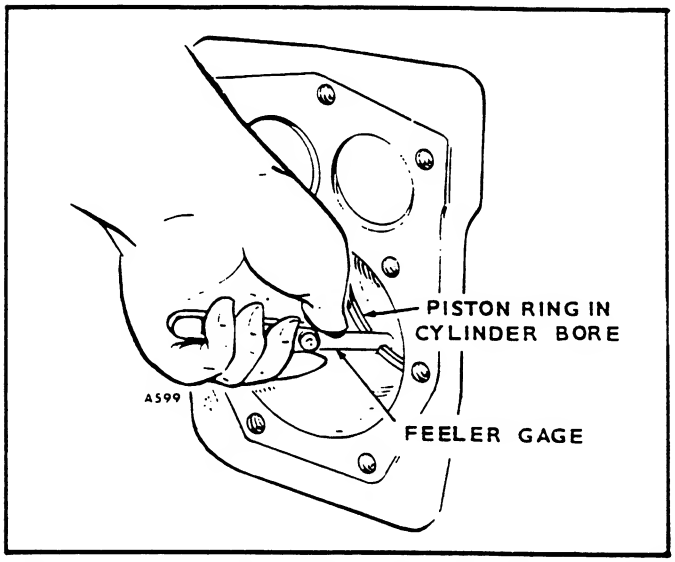


FIGURE 31. FITTING PISTON RINGS TO THE CYLINDER

ring gap by placing each ring squarely in its cylinder at a position corresponding to the bottom of its travel (see Figure 31). The gap between the ends of the ring is given in the Table of Clearances. Rings which are slightly oversize may be filed as necessary to obtain the correct gap, but do not use rings which require too much filing. Standard size rings may be used on .005″ oversize pistons. Rings that are .010″, .020″, .030″ and .040″ oversize are to be used on corresponding oversize pistons. Rings of the tapered type are usually marked *top* on one side, or identified in some other manner and the ring must be installed with this mark toward the closed end of the piston.

Space each ring gap one third of the way around the piston from the preceding one, with no gap directly in line with the piston pin. The bottom piston ring groove should be fitted with an expander and an oil control ring and the two upper grooves fitted with compression rings. If a chrome faced ring is used, it will be in the top groove. The oil control ring is selected for best performance in regard to the correct unit pressure characteristics.

The piston is fitted with a full-floating type piston pin. The pin is kept in place by two lock-rings in the piston, one at each side. Be sure these lock rings are properly in place before installing the piston and connecting rod in the engine. Refer to Table of Clearances for the correct piston-to-cylinder clearance.

CONNECTING RODS

The connecting rods should be serviced at the same time the pistons or rods are serviced. Rods must be removed with the piston. Replaceable bushings and bearings are used. Bearings are available in standard or .002″, .010″, .020″ or .030″ undersize.

Proper clearance is obtained by replacing the pin bushing and the bearings. The rod bearings are precision size and require no reaming.

Install the connecting rods and caps with raised lines (witness marks) aligned and with the caps facing toward the oil base. The rod and cap numbered 2 fits on the crankshaft journal nearest the bearing plate. Coat the crankshaft journal bearing surfaces with oil before installing the rods. Crank the engine by hand to see that the rods are free. If necessary, rap the connecting rod cap screws sharply with a soft-faced hammer to set the rod square on the journal.

CRANKSHAFT

Inspect the bearing journals. If they are scored and cannot be smoothed out by dressing down, the bearing journals should be refinished to use nearest available undersize bearings or a new crankshaft should be installed. If a worn main bearing journal cannot be fitted with an available precision type undersize bearing, then refinish it to the next undersize. If a worn rod journal cannot be fitted by installing new bearing inserts (Forged Rod), then refinish it to take the corresponding undersize bearing insert available.

Whenever making major repairs on the engine, always inspect the drilled passages of the crankshaft. Clean them to remove any foreign material and to assure proper lubrication of the connecting rods.

BEARINGS

Removal of the camshaft or crankshaft bearings requires complete disassembly of the engine. Use a press or a suitable drive plug to remove the bearings. Support the casting to avoid distortion and avoid damaging the bearing bore during removal and installation. Use oil on the bearings to reduce friction when installing and again lubricate with oil after installing (see Figure 32). Use bearing drivers to install camshaft bearings .

Replacement camshaft bearings are precision type which do not require line reaming or line boring after

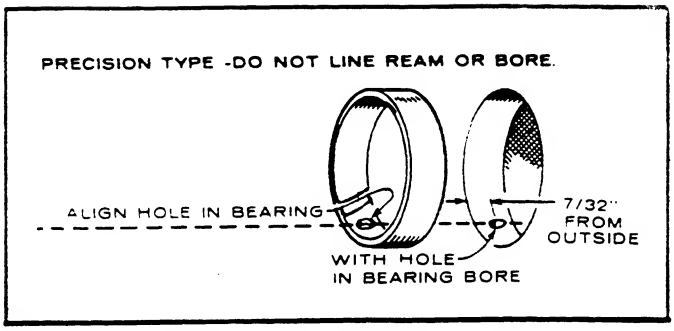


FIGURE 32. CAMSHAFT BEARING

installation. Coat the bearing with lubricating oil to reduce friction. Place the bearing on the crankcase over the bearing bore with the lubricating hole (front only) in proper position. Be sure to start the bearing straight. Press the front bearing in flush with the outside end of the bearing bore. Press the rear bearing in until past the ignition plunger hole.

New crankshaft main bearings are precision type which **do not** require line reaming or line boring after installation. They are available in standard size. .002". .010". .020" or .030" undersize.

Before putting in the main bearings. expand the bearing bore by placing the casting in hot water or in an oven heated to 200°F. If practical. cool the precision bearing to shrink it.

For putting in either the front or rear main bearing, using instructions following, always align the oil hole(s) in the bearing with the oil hole(s) in the bearing bore. The oil passage must be at least 1/2 open.

The cold oiled precision bearing should require only light taps to position it.

NOTE: *Earlier units had thrust washer bearings and main bearings on front and rear of the engine. Current engines use a thrust washer and main bearing for the rear bearing plate while the front of the engine uses a one piece bearing. All engines should now use the new one piece bearing for overhaul or repair.*

In the rear bearing plate. install the bearing flush to 1/64" below the end of the bore using combination driver. See Figure 33.

NOTE: *If the special combination tool isn't available. it's necessary to remove the lock pins with side cutters or Easy Out tool. After the bearings are installed. insert new lock pins.*

Before installing the front bearing (Figure 34). use the Locktite Bearing Mount furnished in the bearing kit. Use the towelette in the package to clean the outside of the bearing and the bearing bore in the block.

WARNING *Breathing vapor from towelette and prolonged contact with skin can be harmful. Be sure area is well ventilated.*

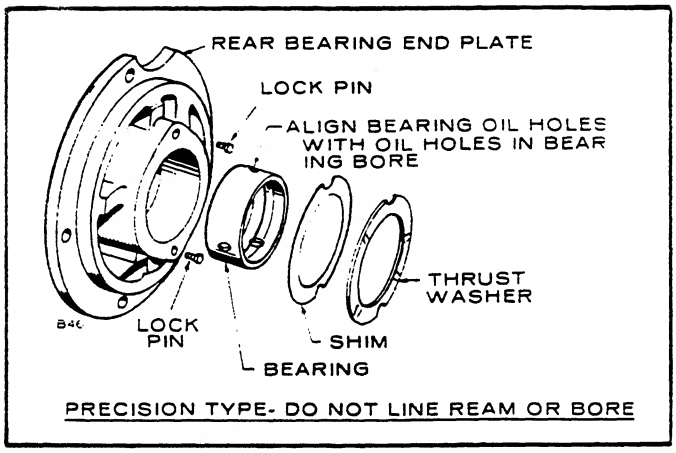


FIGURE 33. BEARINGS FOR REAR BEARING PLATE

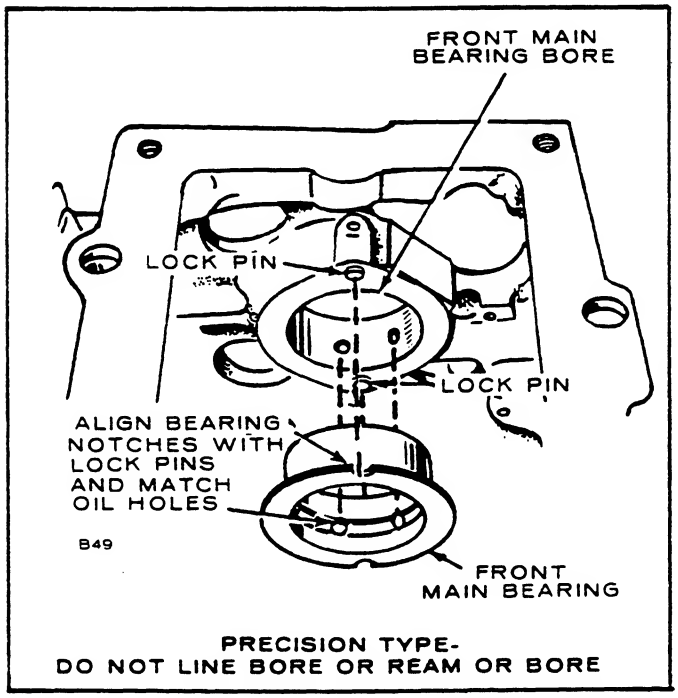


FIGURE 34. FRONT MAIN BEARING INSTALLATION

After allowing three to four minutes for drying, apply the Locktite Bearing Mount from the small tube to the mating surfaces of the bearing and bearing bore. Install the bearing flush with the block using the combination driver just used for the rear bearing. Wipe off any excess Locktite around the bearing. Allow at least one hour for hardening at room temperature.

Lubricate the front main bearing lightly with oil and insert the crankshaft. With the rear bearing plate gasket in place and the rear end plate bearing lubricated. slide the thrust washer (grooves toward crankshaft) and plate over the end of the crankshaft. Line up the notches of the thrust washer with the lock pins before tightening the end plate or the lock pins will be damaged.

NOTE: *A light film of oil on the thrust washer may*

hold it in place while installing the crankshaft.

CRANKSHAFT ENDPLAY

After the rear bearing end plate has been tightened using the torque recommended in Assembly Torques and Special Tools, check the crankshaft endplay as shown in Figure 35. If there is too much endplay (see Dimensions and Clearances for minimum and maximum endplay), remove the rear bearing end plate and add a shim (Figure 33) between the thrust washer and plate. Reinstall the end plate making sure the thrust washer and shim notches line up with the lock pins. Torque and recheck endplay of the crankshaft.

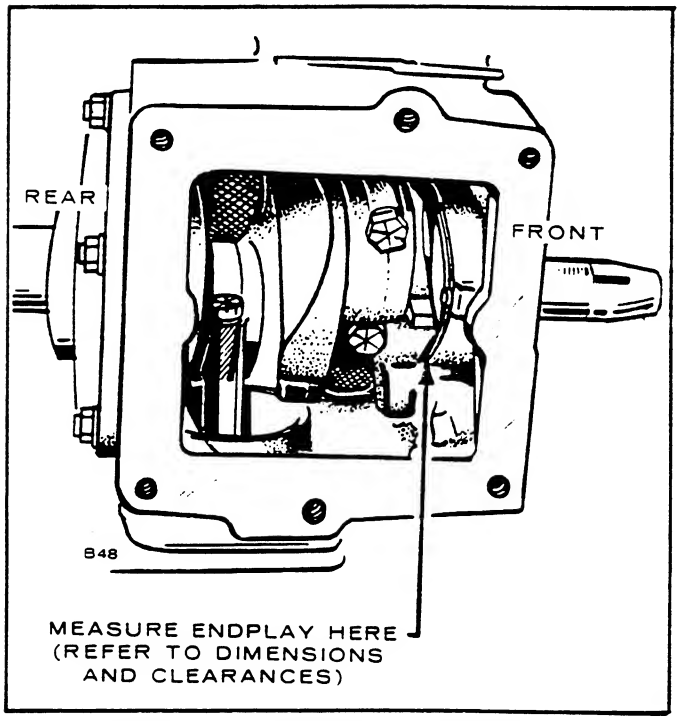


FIGURE 35. CRANKSHAFT ENDPLAY

OIL SEALS

The bearing plate must be removed to replace its oil seal. Drive the oil seal out from the inside using bearing plate driver 420-0181 and gear cover driver 420-0313.

Before installing the seals, fill the space between seals with a fibrous grease or stiff cup grease. This will improve sealing (See Figure 36).

When installing the gear cover oil seal, tap the seal inward until it is 31/32 of an inch from the mounting face of the cover. Install new style, thin open face seal, 1-7/64 inches from mounting face of cover.

When installing the bearing plate oil seal, tap the seal into the bearing plate bore to bottom against the shoulder in the plate bore. Use a seal expander, or place a piece of shim stock around the end of the crankshaft, when replacing the bearing plate to avoid damaging the seal. Remove the shim stock as soon as the plate is in place.

OIL PUMP

To remove the oil pump, it is necessary to detach the intake cup assembly as shown in Figure 37.

Check the oil pump thoroughly for worn parts. Oil the pump to prime it before reinstalling. Except for gaskets, the component parts of the pump are not available individually. The suction cup is available separately. Install a new pump assembly, if required.

CYLINDER

The cylinder wears very little in normal service. If, through improper lubrication or accident, the cylinder wall should become scored or worn badly, the cylinder may be rebored and honed to accomodate a new piston and ring set of the available oversizes. Pistons are available in .005", .010", .020", .030" and .040"

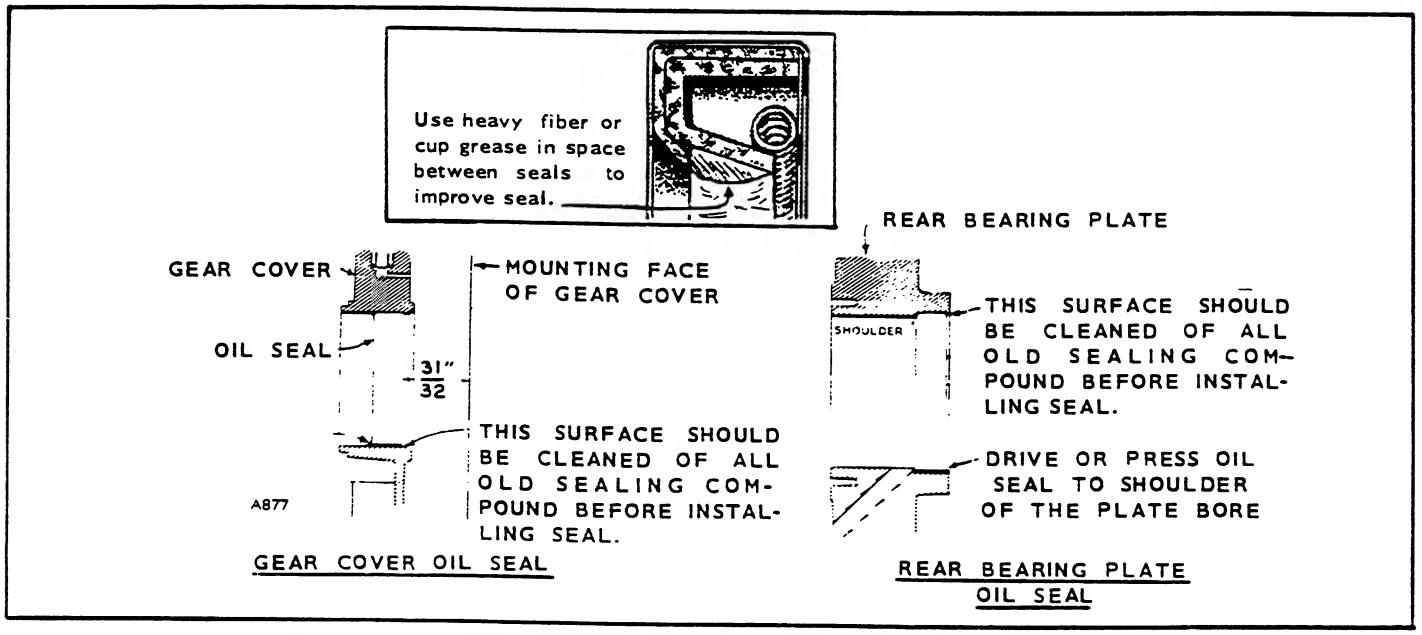


FIGURE 36. GEAR COVER AND REAR BEARING PLATE OIL SEALS

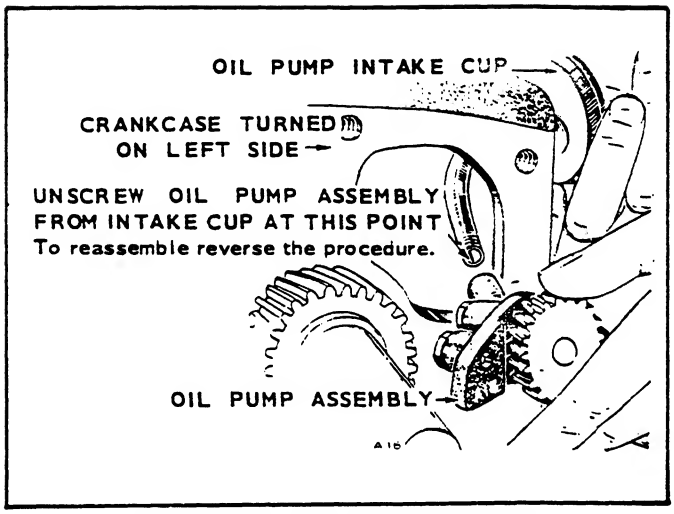


FIGURE 37. OIL PUMP ASSEMBLY

oversize. Piston rings are available in .010″, .020″, .030″ and .040″ oversize. Use standard size rings on a .005″ oversize piston. If the cylinder is not being installed. remove any ridge which may have become formed at the top of piston ring travel in the cylinder bore. Engine must be fitted at the factory with a .005″ oversize piston and are so indicated by a letter E following the engine serial number stamped on the cylinder block and on the unit nameplate.

The standard cylinder bore size appears in Table of Clearances.

AC GENERATOR MAINTENANCE

GENERATOR MAINTENANCE

The generator set uses a revolving armature and normally needs little care other than a periodic check of the brushes, commutator and collector rings. If a major repair job on the generator should become necessary, have the equipment checked by a competent electrician who is thoroughly familiar with the operation of electric generating equipment.

BRUSH REPLACEMENT

Install new commutator brushes when the old ones are worn to 5/8" in length. The collector ring brush may be used until worn to 5/8" in length. It is necessary to remove the brush blocks to install new brushes. Remove the band and three screws to expose the brushes. The brushes and leads are then easily accessible (Figure 38). New brushes are shaped to fit and seldom need sanding to seat properly. Always use the correct brush as listed in the parts list, never substitute a brush which may appear to be the same, but may have different electrical characteristics. Be sure to tighten the brush lead terminal nuts. If some brush sparking occurs after replacing brushes, run the set at a light load until the brushes wear to a good seat.

Replace springs if damaged or if proper tension is questionable. To remove the brush, press down on the spring holder and out. Then lift the brush from the guide. Spring tension for the DC brushes is 30 to 34 ounces and for the AC brushes is 16 to 20 ounces. Always replace a brush spring if it's twisted, bent or broken.

CAUTION *Never bend the constant-pressure spring over the edge of its support.*

Rapid brush wear may be caused from high mica between commutator bars, rough commutator or collector rings or from a deviation from "neutral" position in the adjustment of the brush rig.

Collector rings acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright newly machined appearing surface. Ordinary cleaning with a dry, lint free cloth is usually sufficient. Very fine sandpaper (#00) may be used to remove slight roughness. Use only light pressure on the sandpaper, while the set is operating. Do not use emery or carborundum paper or cloth. Clean out all carbon dust from the generator.

Measure brush wear as illustrated in Figure 39.

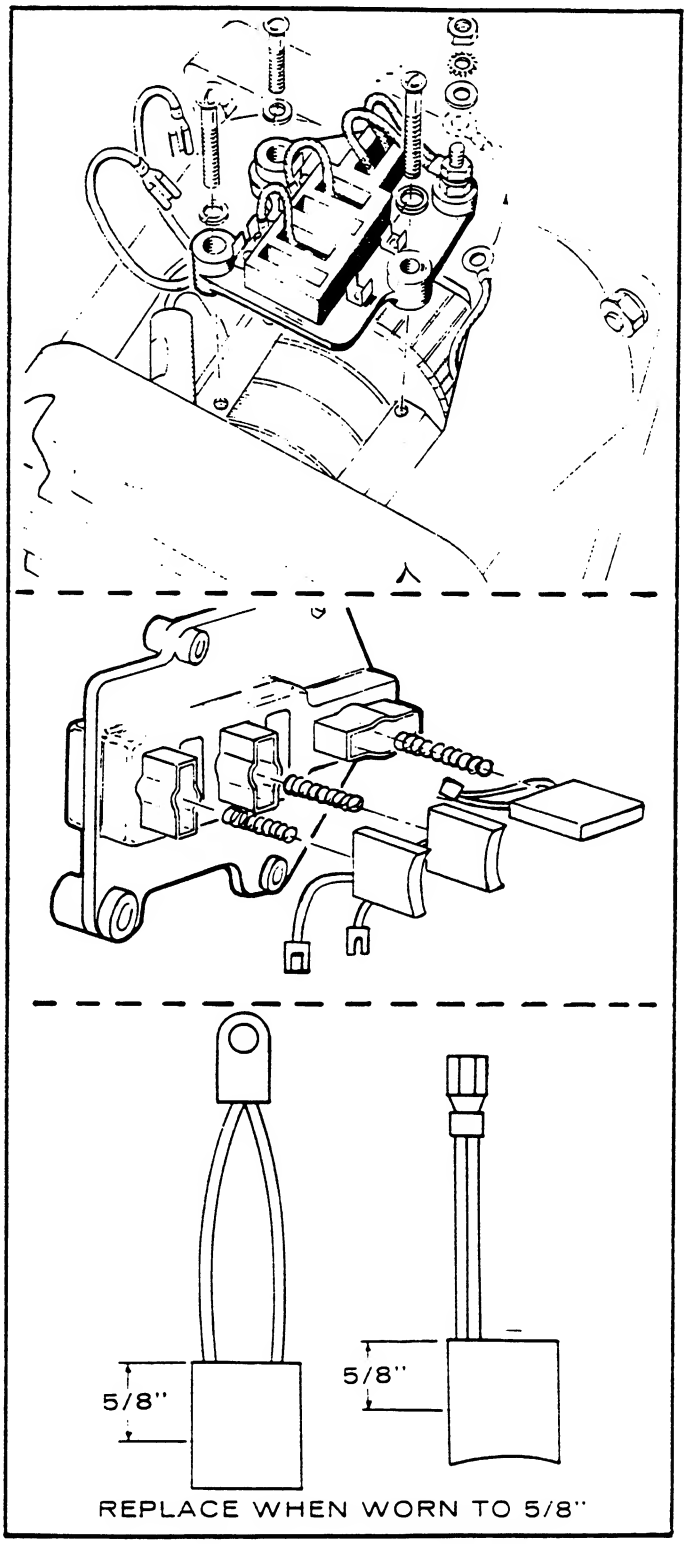
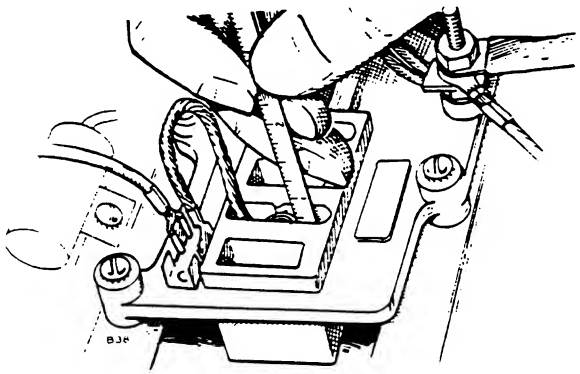


FIGURE 38. GENERATOR BRUSHES

GENERATOR DISASSEMBLY

The procedure is mostly self-evident (see Figure 40). Remove the band and end cover. Lift all brushes using alligator clips (12) or in an emergency the leads may be bent over the sides of the holder.

Remove generator through stud nuts. Hold both the end bell with its brush rig and the frame assembly, since they are separate parts, and remove them as one assembly from the adapter. Screwdriver slots in the adapter



MEASURE FROM TOP FACE OF BRUSH BLOCK TO TOP OF BRUSH

	DC	AC
NEW	5/8"	11/16"
½ WEAR	13/16"	7/8"
REPLACE	1"	1 1/16"

FIGURE 39. MEASURING GENERATOR BRUSHES

provide for prying the frame loose. Be careful not to let the frame assembly rest or drag on the armature.

Turn the armature nut out to the end of the armature through stud. While pulling outward with one hand under the armature strike a sharp end-wise blow on the nut to loosen the armature. Remove the armature and blower as an assembly. The blower is a keyed and pressed fit on the armature shaft, and is a keyed and tapered fit to the engine crankshaft.

If the armature does not come loose, place a heavy brass rod on the armature shaft near the ball bearing and strike a sharp downward blow on the rod with a hammer. Rotate the armature 1/2 turn before repeating. Do not strike the commutator, collector rings, or bearing.

ARMATURE SHORT CIRCUIT TEST

To test for a short circuit, place the armature in a growler (Figure 41). With the growler current on, hold a steel strip about 1/2" above the armature laminations. Pass the strip back and forth over the lamination. Cover as much of the lamination area as possible. If the strip is magnetically attracted to the armature at any point, a short circuit is indicated. After testing in one position, rotate the armature slightly in the growler and repeat the test. Continue until a complete revolution of the armature in the growler has been made. Replace a short circuited armature with a new one.

TESTING FIELD WINDINGS

Use a test lamp set for all tests except short circuit tests. The field coils of all AC sets are saturated shunt wound, the Remote Start sets having a series field winding in addition for cranking and battery charging purposes. When testing a field coil assembly, disconnect all of its external leads from their terminals. Tag and mark each lead to assure proper connections when reassembling.

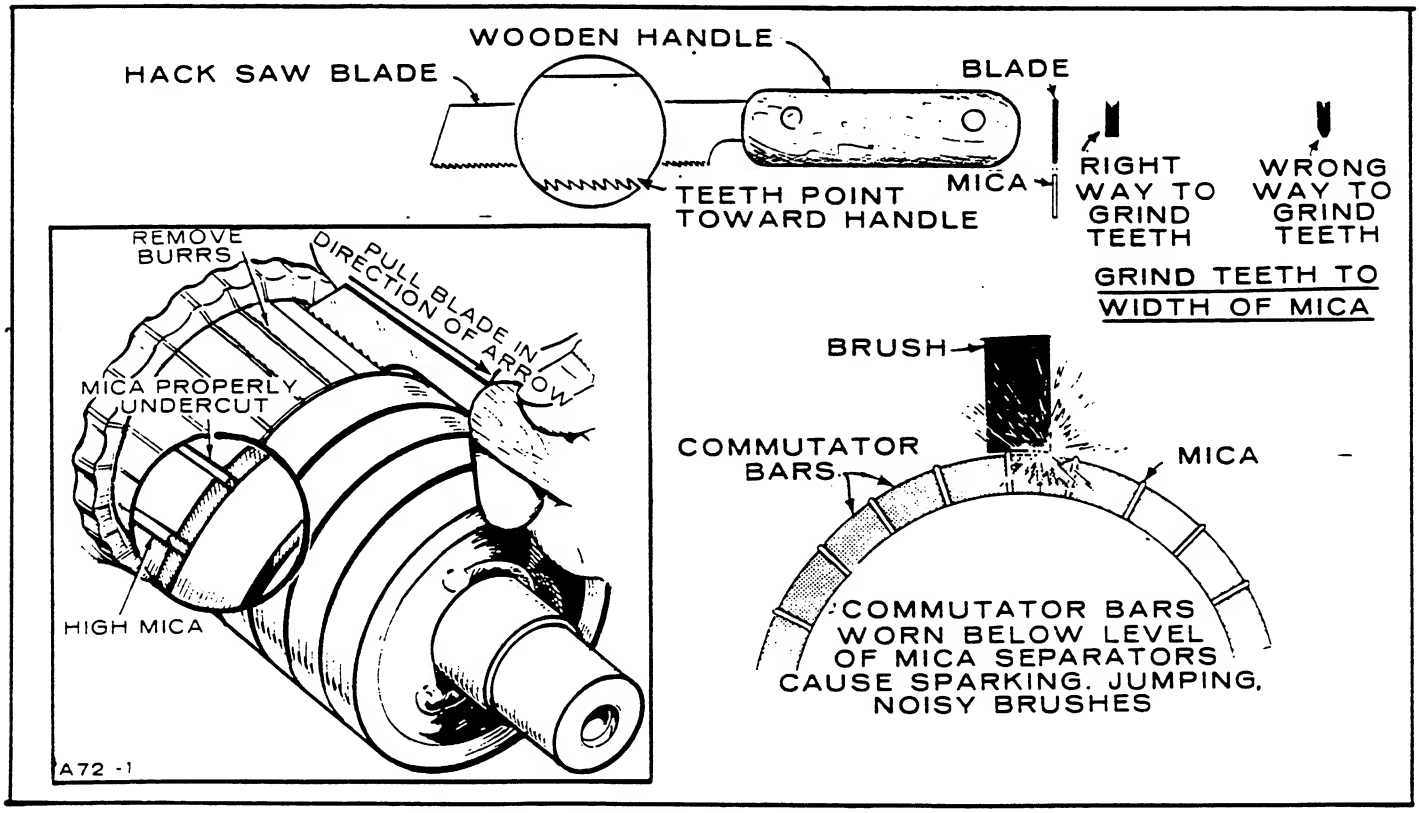


FIGURE 40. UNDERCUTTING COMMUTATOR MICA

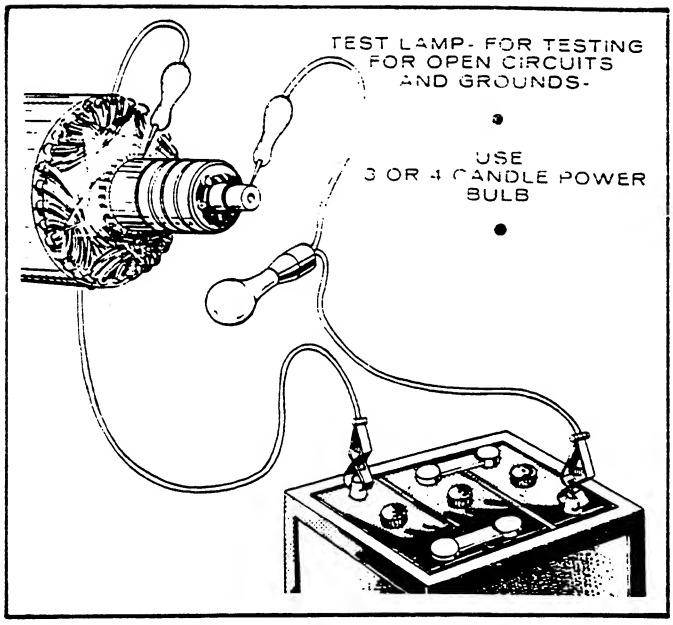


FIGURE 41. TEST CIRCUIT

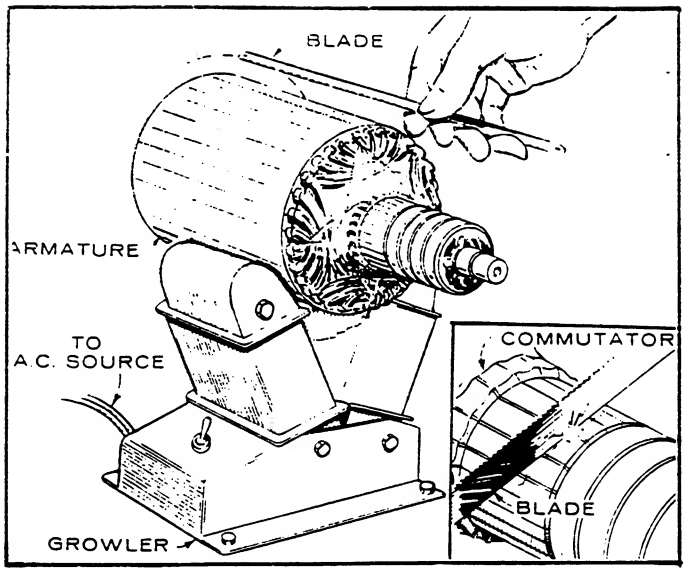


FIGURE 43. TESTING WITH GROWLER

TESTING FIELD WINDING FOR GROUNDS

To test a coil assembly for a ground, disconnect its external leads and touch one test prod to the terminal of one of its leads and the other test prod to the generator frame. If the lamp lights, the coil assembly being tested is grounded. The ground may be in a coil, coil connection, or coil lead. Repair or replace as needed.

TESTING FIELD WINDING FOR OPEN CIRCUIT

To test a coil assembly for an open circuit, disconnect its external leads and touch one test prod to the terminal of one coil winding lead, and the other test prod to the other lead (or leads) of that coil winding. If the lamp does not light, the winding being tested is open. If the fault lies in a connection between coils, or in a coil lead, the connection can be repaired. If it is inside the coil, replace the entire assembly with a new one.

TESTING 4 SLIP RING GENERATOR

If the generator is a single phase model, test between the two slip rings nearest the commutator, and repeat the test between the two rings nearest the ball bearing. In each case the test lamp should glow. If the test is made between the two center rings the test lamp should not glow. If the test lamp does glow, a short circuit between the separate windings is indicated.

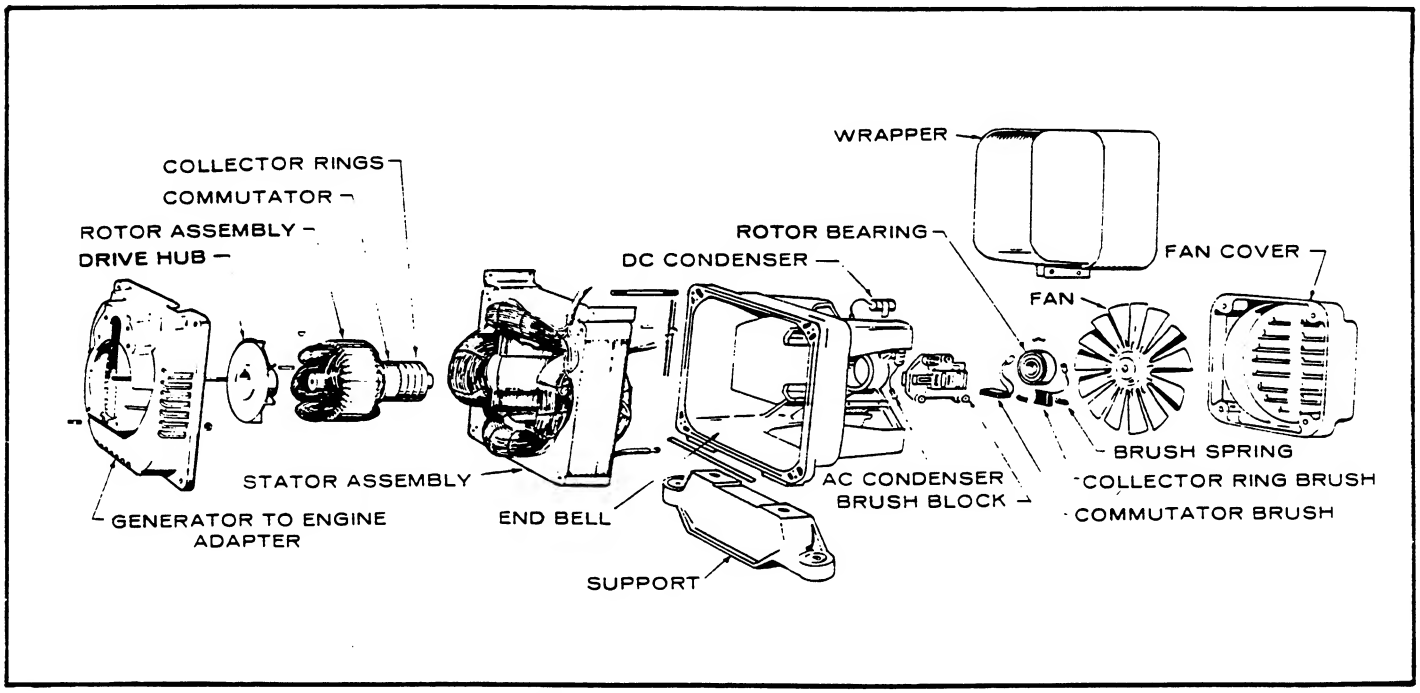


FIGURE 42. GENERATOR ASSEMBLY

To test the DC winding, place the armature in a growler. With the growler current on, pass a smooth steel strip across the commutator segments. Repeat all around the commutator. At some point around the commutator. a spark should occur as the strip contacts two adjacent segments. Rotate the armature slightly and repeat the test. Continue until a spark is obtained between all adjacent segments. If no spark is obtained at some point. an open circuit is indicated.

NOTE: *A short circuit in the winding may prevent sparking. This condition may be indicated by the short circuit test described in the armature short circuit test. Replace an open-circuited armature with a new one.*

BALL BEARING

If replacement of the armature ball bearing becomes necessary, pull the bearing from the shaft with a suitable bearing puller. Be careful not to damage the armature shaft because it must remain true to serve as a turning center when refinishing the commutator or collector rings. Drive the bearing on to the shoulder on the shaft. Use a double-sealed prelubricated ball bearing.

COLLECTOR RINGS

If collector rings become grooved or out-of-round, or the brush contact surface becomes pitted or rough so that good brush seating cannot be maintained, remove the armature and refinish the collector rings in a lathe. If the commutator appears to be rough or scored, refinish it at the same time. Remove or adequately shield the ball bearing during refinishing.

COMMUTATOR

The commutator gradually wears with use. If the proper brushes have been used, and they have been replaced at the proper intervals, this wear will be slow and even. Under dusty conditions or if improper brushes have been used, the wear may be accelerated. Improper or excessive cleaning with sandpaper may cause the commutator to become grooved or out-of-round. Refinish in a lathe.

TURNING COLLECTOR RINGS OR COMMUTATOR (Using a Lathe)

When a collector ring or commutator becomes grooved, worn out-of-round or pitted, it should be turned true on a lathe. This operation is easily performed by any qualified lathe operator. Remove the armature and center accurately on the lathe. Turn the commutator or collector ring enough to provide a perfectly true surface. Tool marks can be removed by using number 00 sandpaper.

After turning the slip rings, cut a slight chamfer on them to remove burrs and sharp edges. This reduces the possibility of a "flash over" between the rings. After turning the commutator, the mica insulation between the commutator bars must be undercut as described in the paragraph "UNDERCUTTING THE MICA INSULATION."

NOTE: *Always install new brushes after servicing slip rings and commutator.*

UNDERCUTTING THE MICA INSULATION

When the commutator wears down so that the mica insulation between any bars comes in contact with the brushes, it will cause the brushes to "jump", spark, be noisy in operation and wear rapidly. Sparking brushes lower the efficiency of the generator and burn the commutator (Figure 40). When a "high mica" condition exists or after commutator has been turned on a lathe, mica insulation requires undercutting.

To undercut the mica, center the cutting tool over the mica and with a firm, steady pull draw the tool the length of the commutator.

CAUTION *Be careful not to draw the undercutting tool into the slip rings.*

Repeat the cutting operation until the mica has been cut down to approximately 1/32 inch below the surface of the commutator. As each section of mica is cut to the proper depth, proceed to the next one until all are equally undercut. If any burrs are present along the edges of the bars after the mica is undercut, carefully remove them. This is done by holding a piece of number 00 sandpaper against the commutator with a perfectly flat piece of wood while the commutator is turning rapidly. Before putting the armature back into service, be sure to blow or brush all mica dust, metallic particles, etc. from the commutator grooves and surface. The edges of the bars on the larger commutators should be beveled to assure a good edge.

CONTROL SYSTEM

SPEC A THROUGH C

GENERAL

The set control system controls starting, stopping, battery recharging and provides a means of emergency automatic stopping. The control system and control system defects should be analyzed with the aid of the proper wiring diagram.

The views shown (Onan wiring diagrams) are modified pictorials. Components are shown in their actual positions and normally the top view of each component is shown, for terminal location. Dotted lines show the edges of the control box and indicate the direction from which it is being viewed, i.e. "Top View". All relays are shown in the de-energized position.

MAINTENANCE

Periodically check all connections and contacts in the control system. Blow out accumulated dust with low pressure air. The breaker point gap of the engine mounted centrifugal switch will have to be checked at regular intervals. This gap should be set at .020".

ELECTRIC STARTING

The control starting circuit consists of a heavy duty starting switch, and the stopping circuit simply of an ignition switch that controls current to the ignition coil. If battery charging or optional emergency shut-off circuits are used, refer to the appropriate sections under remote starting control circuits.

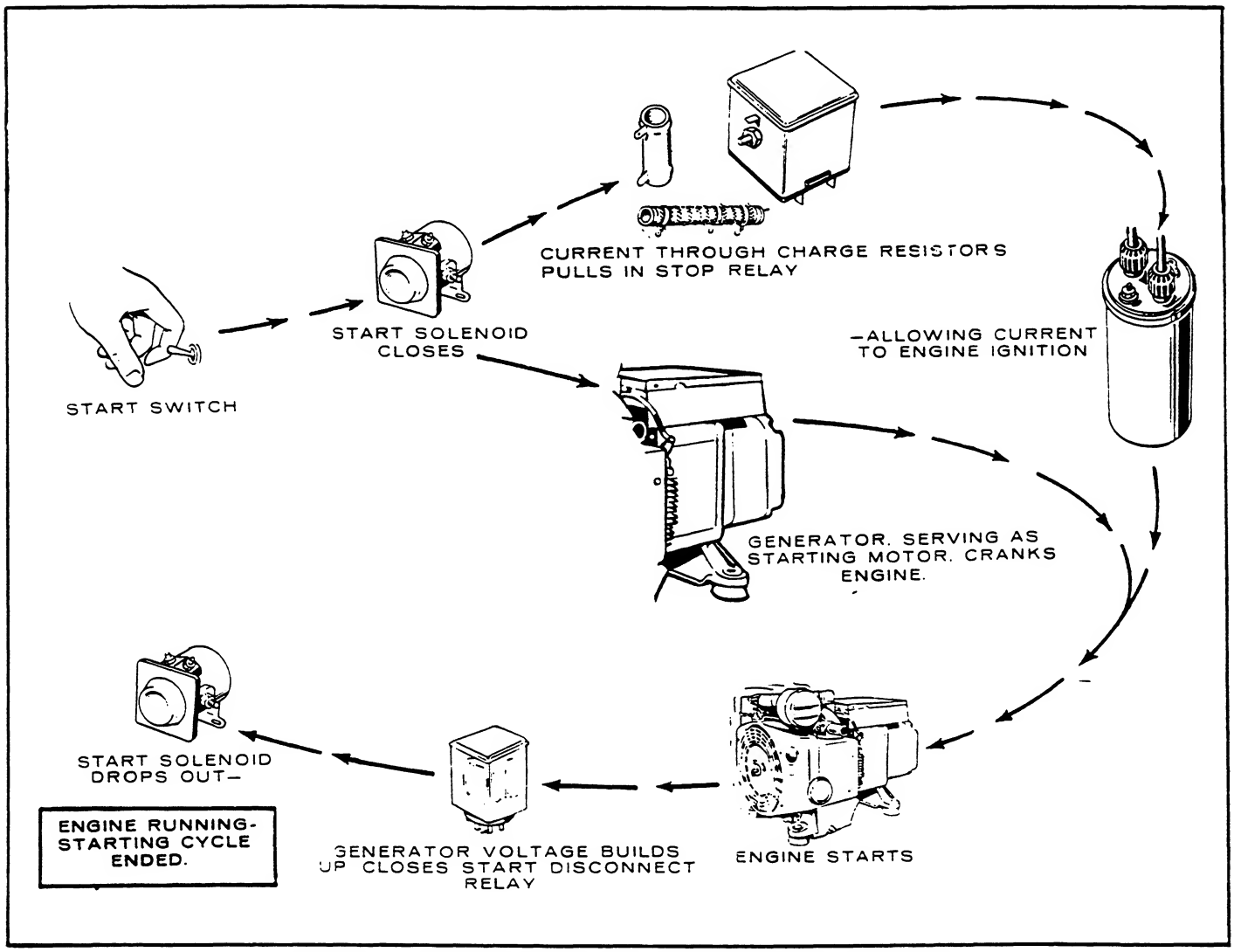


FIGURE 43. STARTING SEQUENCE FOR REVOLVING ARMATURE

TESTING AND REPAIR

These NH sets use the generator as a starting motor. The control system includes the starting circuit, a battery charging circuit with reverse current relay and optional high temperature and low oil pressure cut-offs.

If any component of the control system fails, replace it. Normally, relays cannot be repaired.

Starting and Stopping System: The revolving armature starting system includes the start solenoid, stop relay and start-disconnect relay. Figure 43 shows a starting cycle. To stop the engine, the stop switch grounds the stop relay, breaking the circuit to the ignition coil.

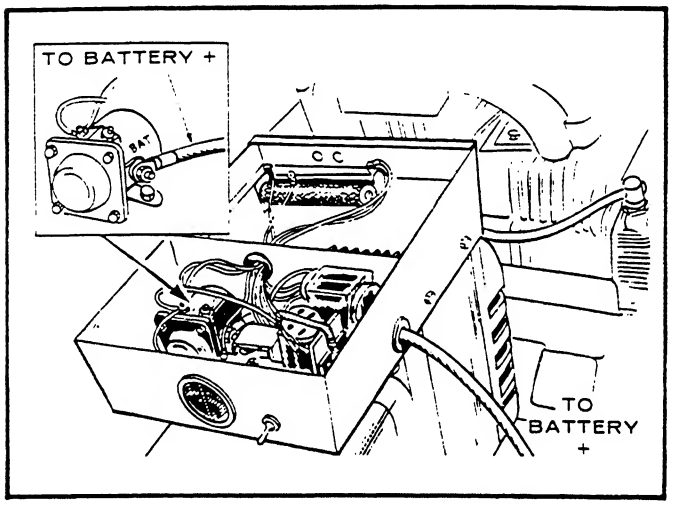


FIGURE 44. START SOLENOID

The starting solenoid controls the heavy currents required by the exciter starting motor(Figure 43).

The Stop Relay controls voltage to the ignition coil. When energized it closes the ignition coil circuit. During starting, the stop relay pulls in at the same time as the start solenoid. The generator's DC output maintains it energized throughout operation. To stop, the stop button grounds the relay, which de-energizes, opening the ignition coil circuit.

NOTE: *This is a 6 volt relay and must be used in series with the 30-ohm voltage dropping resistor.*

Check the coil resistance (it should be about 30-ohms), inspect the contacts, and check contact operation when voltage is applied to the coil. If the contacts are dirty, they can be cleaned with hard paper or gauze moistened with carbon tetrachloride.

The Start-Disconnect Relay is energized by the generator DC output, so it pulls in when the output builds up to 10 or 11 volts and remains energized throughout set operation. When the relay pulls in, it opens the circuit to the start solenoid coil, opening that solenoid to break the starting circuit. To test this relay, inspect the contacts, check the coil resistance (it should be 20 to 24-ohms) and check contact operation when the set starts.

Battery Charging Circuit: The generator DC windings supply current for the battery charging circuit. The current flows through the reverse current relay, charge ammeter and the adjustable charge rate resistor, located outside the control box.

The battery charge rate can be adjusted between 2 and 5 amps by moving the slider on the charge resistor.

The start disconnect relay allows current flow only from the generator to the battery and opens when current attempts to flow in the other direction. To test the relay, isolate it by removing the generator connection (GEN). Check for continuity between the battery and generator terminals. Continuity here indicates that the relay contacts are welded together. Measure the resistance from the generator terminal to ground. This should be approximately 112-ohms.

Automatic Emergency Stopping: The optional emergency stopping system includes two separate devices, the high temperature cut-off and low oil pressure cut-off. Both devices are optional equipment.

NOTE: *When the generating set is used with Load Transfer or Automatic Demand Controls and one of the emergency stopping devices operates, the engine will stop and then crank until the control's cranking limiter opens.*

The High Temperature Cut-off Switch (Optional) is located in the optional air shutter or air duct. Normally closed, it opens when the air temperature reaches 240°F ±6 and closes again when the temperature drops to 195°F ±8. The engine cannot be started again until the switch closes.

The Low Oil Pressure Circuit (Optional) includes a non-adjustable low oil pressure switch and centrifugal switch located on the engine and a latching relay in the control box. The circuit shuts the engine down if oil pressure drops below 7 ±1 psi and prevents it from restarting until the operator pushes a reset button on the control box.

If low oil pressure occurs, the pressure switch closes, completing the relay coil circuit. The relay pulls in and latches after 15 to 20 seconds. The centrifugal switch is required to prevent the circuit from latching during the engine starting cycle, before oil pressure builds up.

SOLID STATE CONTROL SYSTEM - BEGIN SPEC D

The NH electric generating sets beginning with Spec D have a solid state control system located on top of the generator (Figure 45) for starting, stopping, battery charging, and low oil pressure shutdown.

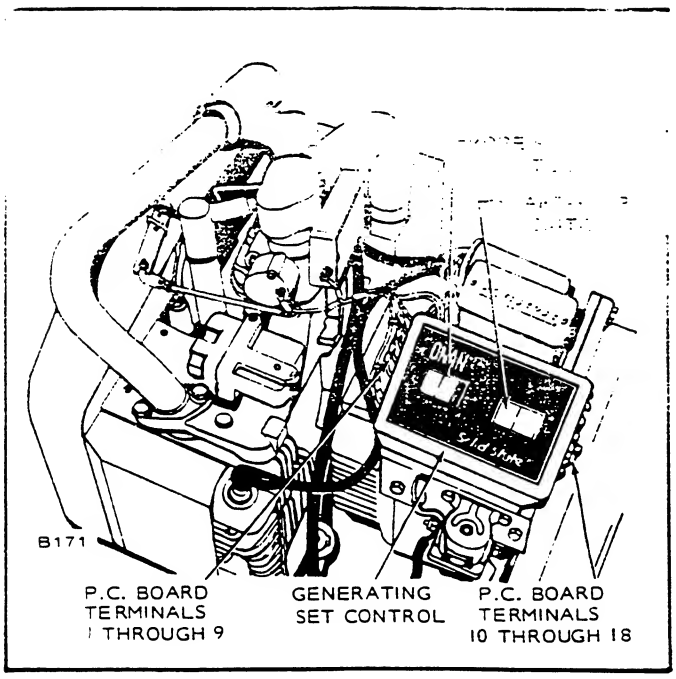


FIGURE 45. GENERATOR SET CONTROL ASSEMBLY

The electric generating set control, comprised basically of a printed circuit board about 4 inches by 7 inches, has two control switches Start-stop switch A1S2 is located on the right side of the control ROPE START switch A1S1 (called HAND CRANK - ELECTRIC or NONFUNCTIONAL on some models) is located on the left side

The start-stop switch A1S2 is pressed to START until the generator set starts. The switch is pressed to STOP until the generator set stops Models with switch A1S1 indicated as ROPE START or HAND CRANK - ELECTRIC, use the switch for manual rope starting (models with rope sheave). Terminals 1 through 9 on the left side of the control connect to the following components:

a Ignition Points - 6
b Ignition Coil - 6
c Start Solenoid - 9
d Low Oil Pressure Shutdown - 4
e Choke - 2
f Battery Charging Resistors - 7 and 8

Terminals 10 through 18 on the right side are for control connections of a remote control station including:

a DC Voltmeter - 13 and 15
b DC Battery Charging Ammeter - 17 and 18
c Running Time Meter - 10 and 13
d Generator "ON" Light - 10 and 15
e Remote Start-Stop Switch - 13, 14, 15 and 16

OPERATION DESCRIPTION

Throughout the descriptions of the control system, components with the prefix "A1" are located on the control board (e.g. A1CR4). Components with prefix "G" are located in the generator (e g G1R1). Refer to Figure 46 throughout the description

Starting: [illegible] battery. Figure 47 [illegible] sequence of [illegible] for solid state controlled generator sets.

Electric Fuel Pump (If Used). At the same time the ignition is energized, the fuel pump is energized, (requires 5.5 volts minimum to operate) from terminal 6 of the control, through fuel pump E1, to ground and back to the battery.

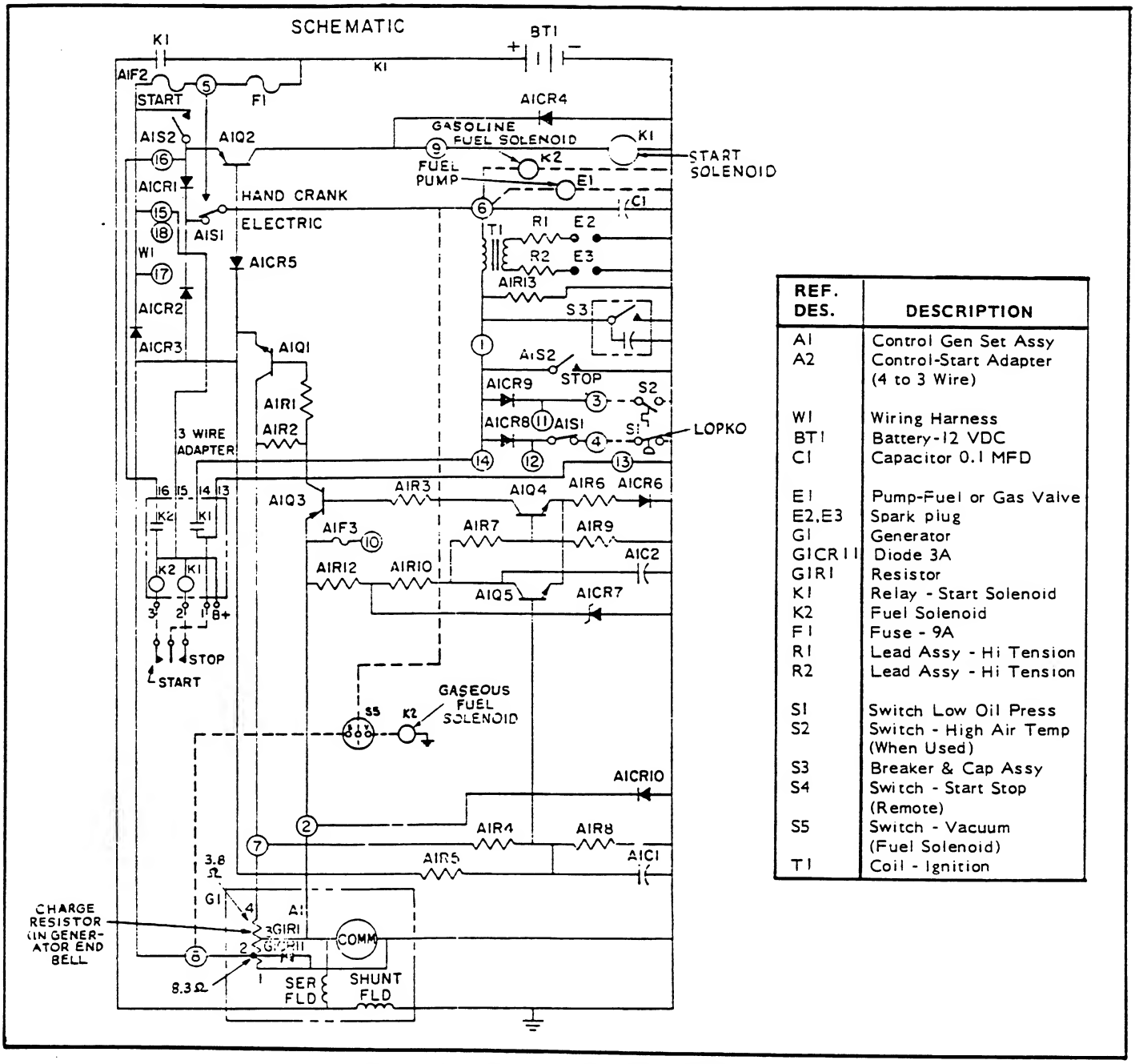
Battery current flows from closed start switch A1S2 through transistor A1Q2, control terminal 9, through the relay coil of start solenoid K1, to ground and back to the battery Relay K1 requires 4.5 volts minimum to operate One of the K1 contacts (main) close connecting the battery to the series field cranking windings of the generator The other K1 contacts close to connect the electric choke, if used, to the battery.

The generator acts as a motor and cranks the engine If sufficient ignition voltage and fuel are present, the engine starts and reaches rated speed.

Start Disconnect: As the generator set builds up speed, generator voltage is supplied to charge resistor G1R1 through both sections – 3.8 ohms and 8.3 ohms When the voltage reaches battery voltage, A1CR5 stops conducting and shuts off transistor A1Q2 to de-energize start solenoid K1 and break the starting circuit Ignition current is now supplied from the generator through charge resistor G1R1, to control terminal 8, diode A1CR2, switch A1S1, control terminal 6 to the ignition coil primary and electric fuel pump (if used).

Low Oil Pressure Shutdown: The low oil pressure shutdown switch S1 is held open during engine operation by engine oil pressure. If oil pressure falls below about 10 psi during cranking or running the ignition circuit is grounded through control terminal 1, diode A1CR8, switch A1S1, low oil pressure switch S1, to ground and back to the battery.

Battery Charging: The two-step battery charging circuits (Figure 48) provide either a continuous low 1.5 amp or a high 5.26 amp charge rate. The low charge circuit (about 1.56 amperes) is from generator control A1, through charge resistor G1R1 (8.3 ohm side) terminal 2, control terminal 8, through A1CR3, control terminal 5, through fuse A1F2 and fuse F1 to the battery. The high charge circuit (about 3.7 amps.) is through charge resistor G1R1 (3.8 ohm side) terminal 4, control terminal 7, transistor A1Q1, diode A1CR3, fuse A1F2, control terminal 5, and fuse F1 to the battery. Together the low and high charge circuits provide about 5.26 amperes during the high charging periods. The high charging circuit switches on each time the generator set is started and switches off whenever the battery is almost



REF. DES.	DESCRIPTION
A1	Control Gen Set Assy
A2	Control-Start Adapter (4 to 3 Wire)
W1	Wiring Harness
BT1	Battery-12 VDC
C1	Capacitor 0.1 MFD
E1	Pump-Fuel or Gas Valve
E2,E3	Spark plug
G1	Generator
GICR11	Diode 3A
GIR1	Resistor
K1	Relay - Start Solenoid
K2	Fuel Solenoid
F1	Fuse - 9A
R1	Lead Assy - Hi Tension
R2	Lead Assy - Hi Tension
S1	Switch Low Oil Press
S2	Switch - High Air Temp (When Used)
S3	Breaker & Cap Assy
S4	Switch - Start Stop (Remote)
S5	Switch - Vacuum (Fuel Solenoid)
T1	Coil - Ignition

FIGURE 46. TYPICAL CONTROL SCHEMATIC

fully charged. Blocking diode A1CR3 prevents the battery from discharging when the generator is stopped

High Charge Rate Control Circuit: Battery voltage and four switching transistors: A1Q1, A1Q3, A1Q4, and A1Q5 control the high charge rate control circuit, Figure 48. The circuit switches on when battery voltage drops to 13 volts automatically turning off transistor A1Q5. This action turns on A1Q4 which then turns on A1Q3. This action turns on A1Q1 which completes the high charge circuit to the battery for charging at the high rate. The circuit switches off when battery voltage reaches about 15 volts automatically turning on transistor A1Q5. This action turns off A1Q4 which then turns off A1Q3. This action turns off A1Q1 which opens the high charge circuit to the battery to stop charging at the high rate.

FUEL SOLENOID VALVE AND FUEL PUMP (MOBILE MODELS)

Evaporative control systems on late model motor homes require a positive fuel shutoff valve to prevent the generator set from flooding when not in use. The fuel solenoid valve is located at the outlet of the electric fuel pump. The fuel solenoid and the fuel pump are energized at the same time as the ignition circuit. See mobile generator set Spec D wiring diagram 611C1086.

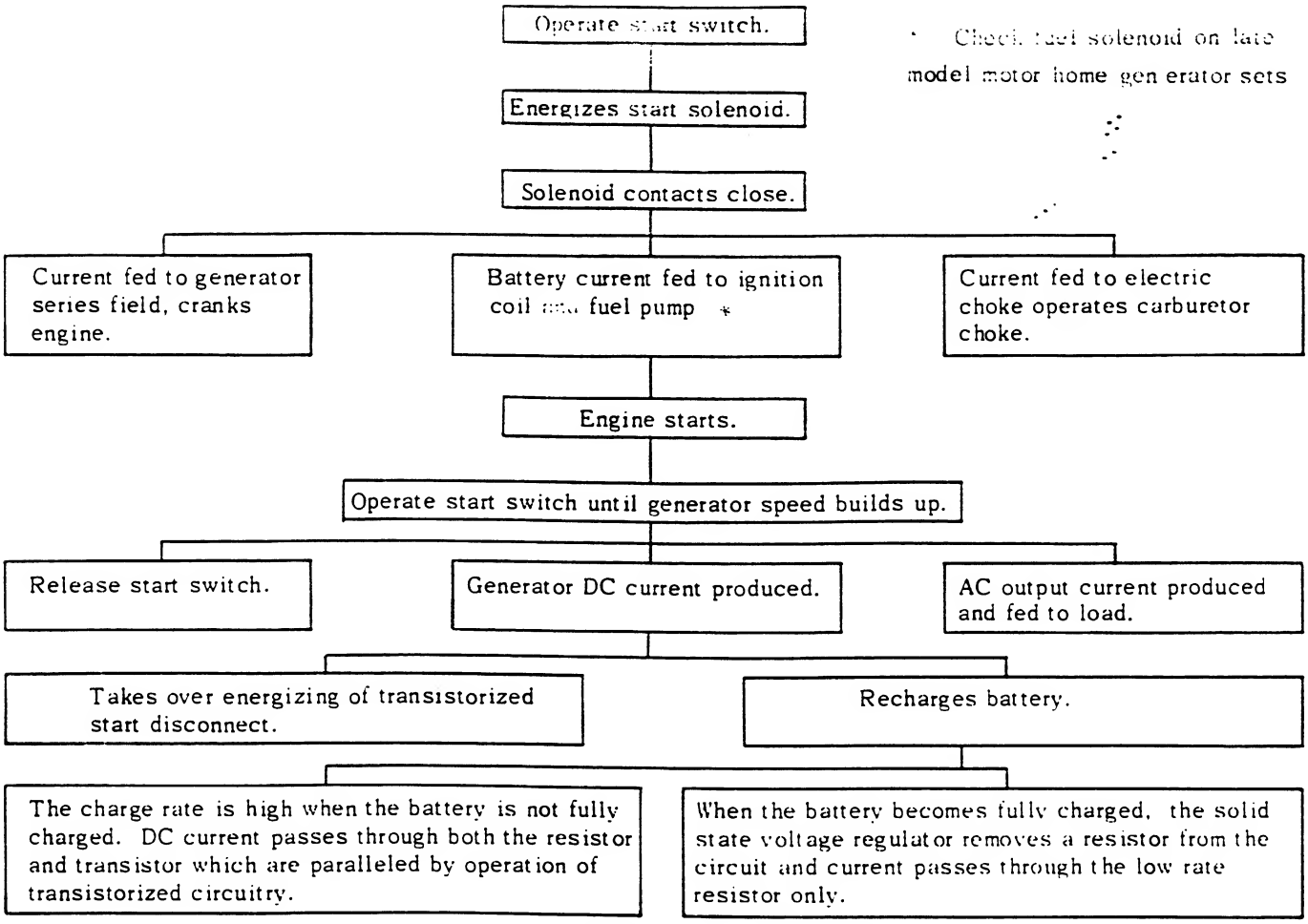


FIGURE 47 SEQUENCE OF OPERATION

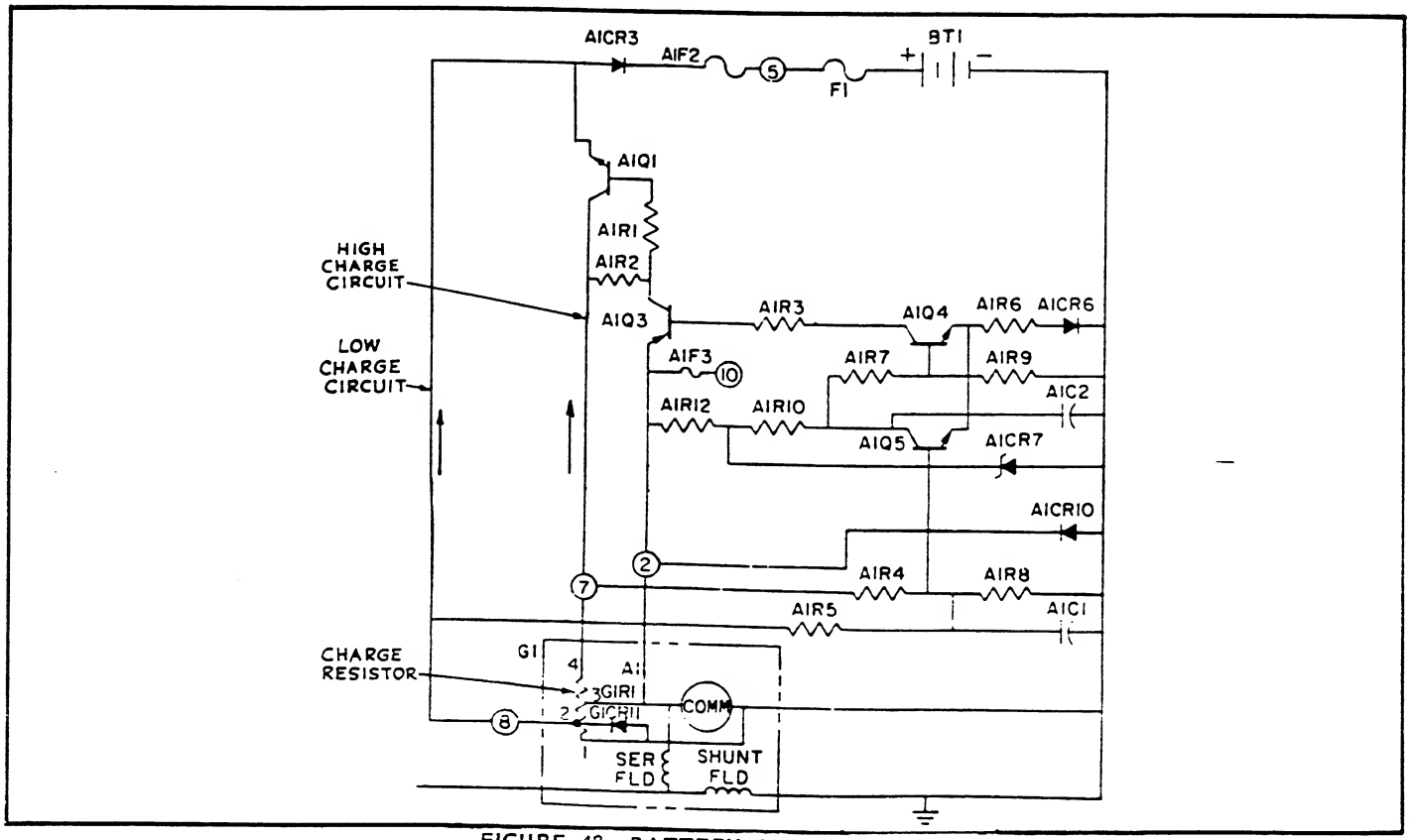


FIGURE 48 BATTERY CHARGING CIRCUIT

TROUBLESHOOTING

This troubleshooting information is divided into five tables, A, B, C, D, and E as follows:

A. Engine does not crank.
B. Engine cranks but does not start.
C. Engine starts but stops when start switch released.
D. Low Battery – no high charge rate.
E. Battery loses excess water.

Always stop the generator set, and disconnect the battery leads before removal of the control cover or control printed circuit board.

To correct a problem, answer the question of the step either YES or NO. Then refer to the step number in the answer column and proceed to that step next.

TABLE A. Engine Does Not Crank	Yes	No
NOTE: *For generating sets with a three-wire start adapter printed circuit board (below the control board) and a remote start-stop station, perform start tests first from the generator set control. If the generator set starts from the generator set control, the problem lies in the three-wire adapter board or the remote switch. Check relay K2 of the adapter by jumping terminal 3 to ground. If the relay does not operate or its contacts do not close to energize start circuit, replace the board.*		
1. Check battery. Are battery cables tight?	2	--
2. Push HAND CRANK - ELECTRIC (called ROPE START or NON-FUNCTIONAL on some models) switch A1S1. Does fuel pump click?	6	3
3. Remove control cover and jumper terminal 5 to terminal 6. Does fuel pump click?	4	5
4. Replace switch A1S1.	--	--
5. Check battery cables for correct polarity. Replace fuse F1 with a 9-ampere, in-line fuse. Push start switch A1S2. Does engine crank?	--	6
6. With start switch A1S2 depressed, is at least 8 volts present from terminal 9 to ground?	7	11
7. Jumper solenoid coil terminal S to battery. Does start solenoid K1 operate?	8	9

VOLTAGE CHECK POINTS

The voltages listed below indicate normal conditions.

Engine Stopped:

12 volts at Pin 5 at all times.
12 volts at Pin 6 when nonfunctional switch A1S1 is depressed on models so designated.

Engine Running:

0 volts at Pins 9, 13, and 16.
10 volts at Pins 1, 3, 4, 11, 12, and 14.
13 volts at Pins 5, 6, 15, 17, and 18.
14 volts at Pins 7 and 8.
28 volts at Pins 2 and 10.

CAUTION *Do not replace the printed circuit board until the trouble has been located and corrected.*

TABLE A. (Continued)	Yes	No
8. Is battery voltage present from right-hand terminal of start solenoid to ground when start solenoid is energized?	10	9
9. Start solenoid is defective and must be replaced.	--	--
10. Perform generator tests. See GENERATOR section.	--	--
11. Is voltage present from terminal 15, 17 or 18 to ground?	14	12
12. With start switch A1S2 depressed, jumper terminal 5 to terminal 15, 17 or 18. Does engine crank and start?	13	14
13. Remove control printed circuit board. Replace A1F2 fuse path with a one-inch length of number 22 wire. Solder in place through holes provided.	--	--
14. Jumper control terminal 5 to terminal 16. Does engine crank?	15	16
15. Replace start switch A1S2.	--	--
16. With start switch A1S2 depressed, jumper control terminals 9 to 16. Does engine crank?	17	--
17. Check transistor A1Q2. If defective, replace control printed circuit board.	--	--

TABLE B. Engine Cranks But Does Not Start	Yes	No
1. Is battery voltage present between control terminal 6 and ground when start switch A1S2 is depressed?	4	2
2. Is battery voltage present between control terminal 6 and ground when start switch A1S1 is depressed?	3	--
3. Faulty switch A1S1 or diode A1CR1. Replace control printed circuit board	--	--
4. Is operation with gasoline?	9	--
5. Does gasoline fuel solenoid operate when switch A1S1 is pressed?	15	6
6. Jumper terminal "VALVE" of gaseous vacuum switch (on intake manifold) to generating set control terminal 6. Does fuel solenoid operate when switch A1S1 is pressed?	7	8
7. Check wire leads to vacuum switch, check switch and replace if necessary.	--	--
8. Check wire leads to gaseous fuel solenoid, check solenoid and replace if necessary.	--	--
9. Does generating set have an electric fuel pump?	10	15
10. Does generating set have a gasoline shut off solenoid?	11	13

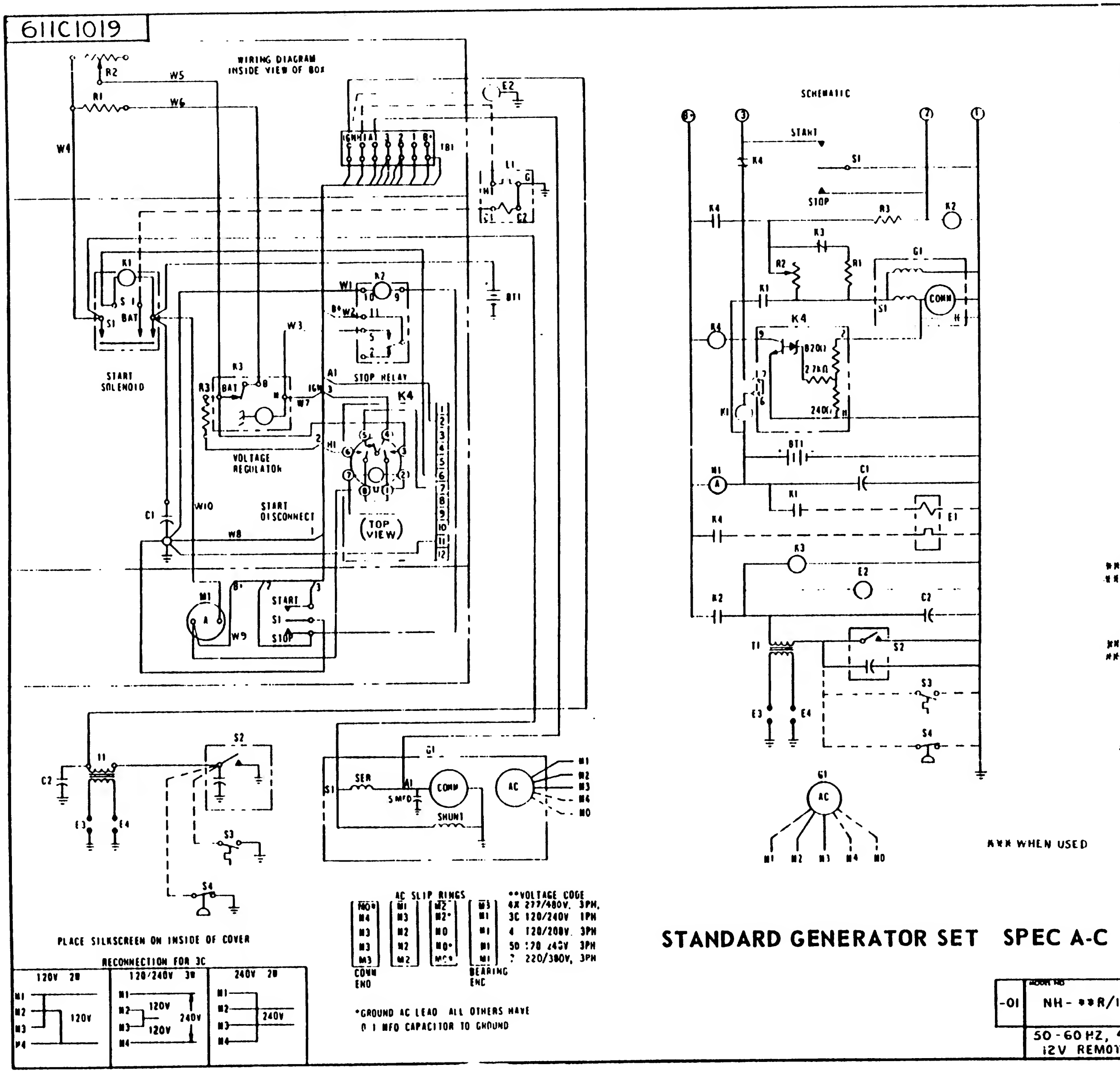
TABLE B. (Continued)	Yes	No
11. Fuel solenoid must be open during cranking and running. Remove the fuel line from carburetor and push switch A1S1. Does fuel pulsate from fuel line?	15	12
WARNING: *Use extreme care for this test. Run fuel into a suitable container and make sure area is well ventilated to prevent accumulation of gasoline fumes.*		
12. Remove fuel solenoid from the fuel line. Push switch A1S1. Does fuel pulsate from the line?	14	13
13. Check wire lead to fuel pump, check fuel pump and replace if necessary.	--	--
14. Check wire leads to gasoline solenoid, check solenoid and replace if necessary.	--	--
15. Check oil level. If okay, remove wire lead for low oil pressure switch S1 from control terminal 4 and push start switch A1S2. Does engine crank and run?	16	19
16. Is wire lead from low oil pressure switch grounded?	17	18
17. Repair or replace wire lead.	--	--
18. Check low oil pressure switch S1 and replace if necessary.	--	--
19. See IGNITION SYSTEM section.	--	--

TABLE C. Engine Starts But Stops When Start Switch is Released	Yes	No
1. Connect voltmeter from control terminal 8 to ground. Check engine. Is there DC voltage output from generator?	3	2
2. Check resistor G1R1 and all resistor connections.	--	--
3. Is voltage present from control terminal 6 to ground after engine starts and start switch A1S2 is released?	--	4
4. Replace printed circuit board.	--	--

TABLE D. Low Battery – No High Charge Rate	Yes	No
1. Remove wire lead from fuse F1 to control terminal 5. Connect DC ammeter between wire lead and terminal 5. Start generator set. Is high battery charge rate present (over 3 amperes)?	2	3
2. Measure battery terminal voltage with voltmeter (one percent accuracy or better). Does voltage rise to 14 volts or more?	4	3
3. Remove control cover and jumper control terminals 7 and 8. Does charge rate increase?	6	5
4. Check battery and replace if necessary.	--	--
5. Stop generator set. Check wire leads to charge resistor G1R1. Check resistor and replace if necessary.	--	--
6. Replace the control's printed circuit board.	--	--

TABLE E. Battery Loses Excess Water	Yes	No
1. Connect a voltmeter (one percent accuracy or better) to battery terminals, start and run generator set for 30 minutes. Does battery terminal voltage exceed: a. 14 volts at 100 F or above; or, b. 15 volts at 50 to 100 F; or, c. 16 volts at 50 F or below?	2	--
2. Replace the control printed circuit board.	--	--

WIRING DIAGRAMS



STANDARD GENERATOR SET SPEC A-C

PARTS LIST

	REF DES	DESCRIPTION
	C1	CAPACITOR 1.0 MFD
	K1	RELAY START SOLENOID
	K2	RELAY STOP
	K3	RELAY 2 STEP VOLTAGE REG
	K4	RELAY ASSY START DISC
		RELAY-START DISCONNECT
*		AMPLIFIER-START DISC
	M1	AMMETER-CHARGE, 10-0-10
	R1	RESISTOR 6Ω, 50 W
	R2	RESISTOR 8Ω, 100 W ADJ
	R3	RESISTOR & LEAD ASSY
		RESISTOR 30Ω 5 W
	S1	SWITCH & LEAD ASSY
		SWITCH START, STOP
	TB1	BLOCK TERMINAL
		STRIP-MARKER
	W1	LEAD ASSY
	W2	LEAD ASSY
	W3	LEAD ASSY
	W4	LEAD ASSY
	W5	LEAD ASSY
	W6	LEAD ASSY
	W7	LEAD ASSY
	W8	LEAD ASSY
	W9	LEAD ASSY
	W10	LEAD ASSY
		SILKSCREEN-RECONNECTION
		LABEL-START STOP
		GROMMET
		GROMMET
		GROMMET
		CONTROL BOX
		COVER-CONTROL BOX
*		SOCKET ASSY - START DISCONNECT
		SPRING
	BT1	BATTERY, 12V
	C2	CAPACITOR, 0.1 MFD
***	E1	CHOKE-THERMO MAG
***	E2	PUMP-FUEL OR GAS VALVE
	E3 4	SPARK PLUG
	G1	GENERATOR
	S2	BREAKER & TAP ASSY
***	S3	SWITCH-HIGH AIR TEMP
***	S4	SWITCH-LOW OIL PRESS
	T1	COIL-IGNITION
*		SPACER

611C1019

LTR	REVISION	CHK	DATE
K	MADE L1 WHEN USED	G.T.	1-20-72
J	ADDED GAS VALVE	G.T.	1-20-72
H	ADDED 4XR MODEL	G.T.	1-20-72
G	REM 301A3305(REF) 2 HOOKS	G.T.	10-14-71
F	ADDED 301A3307 (REF)	G.T.	8-30-71
E	ADDED 3, K4 (REF) DWGS	G.T.	2-16-71
D	ADDED 7R MODEL	G.T.	11-11-70
C	GENERAL REVISIONS		7/7/70
B	ADDED 508P160	G.T.	4-27-70
A	WAS QTY 3	G.T.	4-27-70

SUPSDS DWG SAME NO. DATED 5-28-69 COMPLETLY REVISED

Onan DIVISION OF STUDEBAKER CORPORATION

DATE	DR	CHK	APP
4-9-70	COR	G.T.	J.W.D.

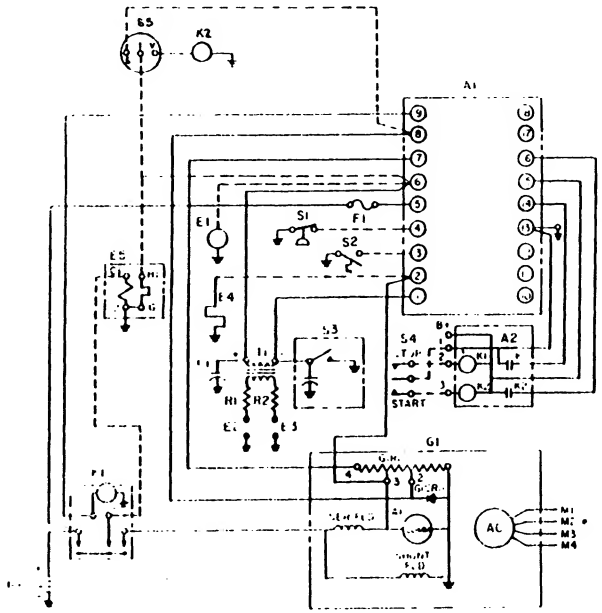
	MODEL NO	
-01	NH - **R/1A	50-60HZ, 4W 12V REMOTE

NAME: WIRING DIAGRAM CONTROL-GEN SET

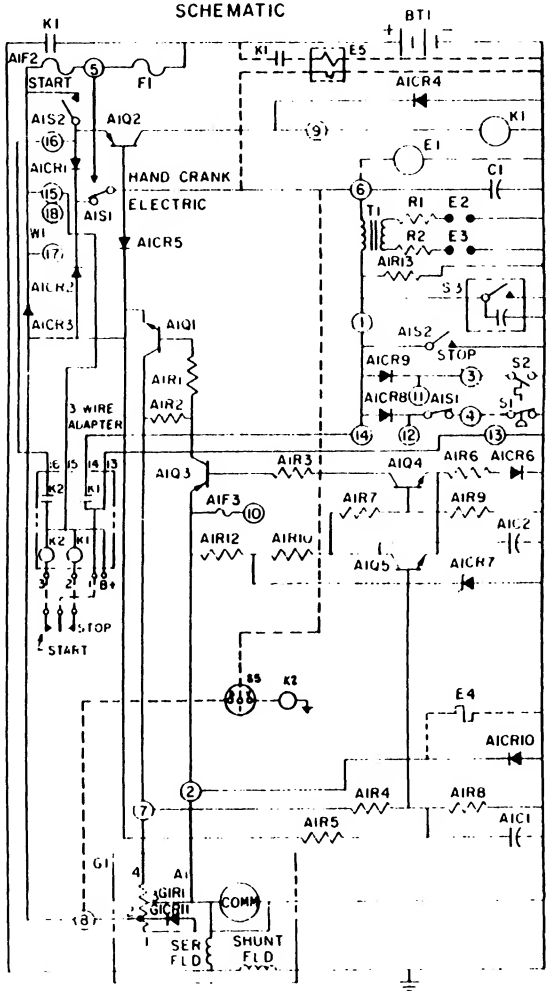
DWG NO 611C1019

611-1090 C

WIRING DIAGRAM



SCHEMATIC



REF DES	DESCRIPTION
	CONTROL ASSY
A1	CONTROL-GEN SET ASSY
A2	CONTROL-START ADAPTER (4 TO 3 WIRE)
B1	WIRING HARNESS
	LIST ENG GEN (REF)
BT1	BATTERY-12 VDC
C1	CAPACITOR-0.1 MFD
E1	PUMP-FUEL OR GAS VALVE
E2,E3	SPARK PLUG
E4	CHOKE (NAN (WHEN USED)
E5	CHOKE THERMO MAG (WHEN USED)
G1	GENERATOR
GICR11	DIODE-3A
GIR1	RESISTOR
K1	RELAY-START SOLENOID
K2	FUEL-SOLENOID
F1	FUSE-9A
R1	LEAD ASSY-HI TENSION
R2	LEAD ASSY-HI TENSION
S1	SWITCH-LOW OIL PRESS
S2	SWITCH-HIGH AIR TEMP (WHEN USED)
S3	BREAKER & CAP ASSY
S4	SWITCH START STOP (CUSTOMER REMOTE)
S5	SWITCH-VACUUM (FUEL SOLENOID)
T1	COIL-IGNITION

0601-119

F	ADDED -12	GT	5-17-73
E	ADDED -11	GT	4-17-73
D	ADDED -10	GT	4-13-73
C	ADDED -08 & -09	GT	3-26-73
B	ADDED -04,-05,-06,-07	GT	3-13-73
A	REM NOTE	GT	2-23-73

SUPERSEDES DWG SAME NO DATED 3-21-72

Onan

2-15-73 | JTM | G.F.T. | W18

CONTROL -GEN SET WIRING DIAGRAM

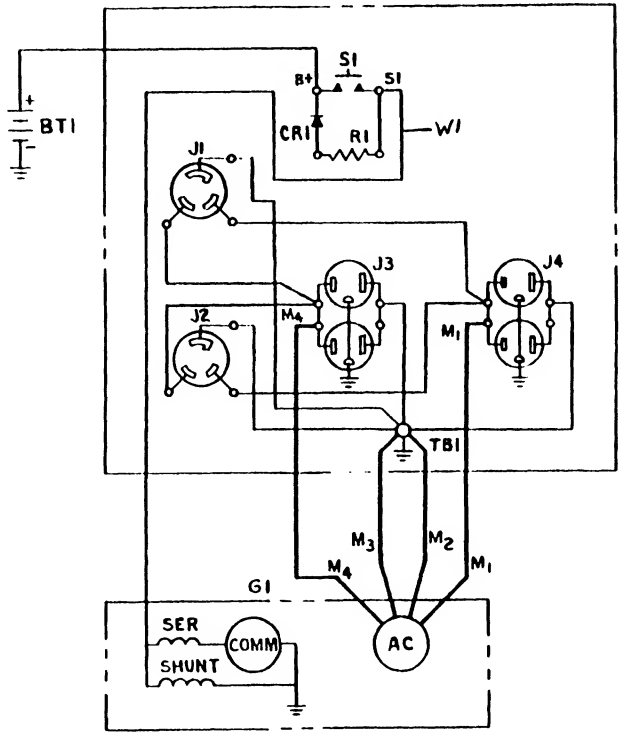
611-1090 C

120/240V, 1 PH., 4 TO 3W, 60Hz

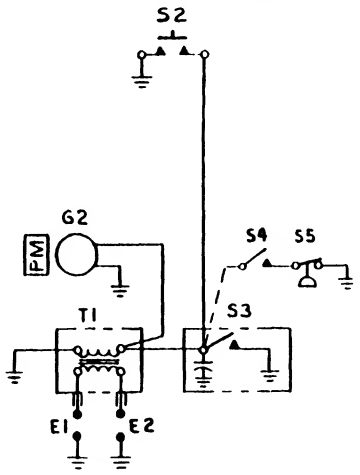
STANDARD GENERATOR SET SPEC D

606B198

TOP REAR VIEW OF PANEL



STOP SWITCH MOUNTED ON BLOWER HSG



* WHEN USED

PARTS LIST

REF. DES.	DESCRIPTION
BT1	BATTERY-12V
CR1	RECTIFIER
	HEAT SINK
E1,2	SPARK PLUG
G1	GENERATOR
G2	MAGNETO
J1,2	RECEPTACLE-TWISTLOCK, 240V
J3,4	RECEPTACLE-DUPLEX, 120V
	JUMPER
R1	RESISTOR, 50W, 10Ω
S1	SWITCH-START
S2	SWITCH-STOP
S3	BREAKER & CAPACITOR ASSY
T1	IGNITION COIL
TB1	TERMINAL-GND
	CONTROL BOX
	PANEL-RECEPTACLE
	SILKSCREEN-CONTROL
	GROMMET
	GROMMET
	GROMMET
W1	LEAD ASSY
	SCREW-HHC, 5/16-18 x 1-2
	WASHER-LK, 5/16
	NUT-HEX, 5/16-18
	SLEEVING-INSULATION, 5/8
* S4	SWITCH-MOMENTARY
* S5	SWITCH-LOW OIL PRESS

LET	REVISION	CKD	DATE
J	REVISED VIEW OF J1 & J2	G.T.	2-13-73
H	WAS 323-11	G.T.	1-17-73
G	ADDED S4 & S5	G.T.	10-13-71
F	ADDED 6.5 NH 3CE/11374C	G.T.	10-13-71
E	ADDED W1	G.T.	1-11-71
D	REVERSED S1, R1 & CR1	G.T.	12-17-70
C	TURNED J3 & J4 180°	HPM	10-13-70
B	ADDED 50CY MODEL	G.T.	8-31-70
A	ADDED TB1	HPM	8-6-70

CONTRACTORS MODEL SPEC A-C

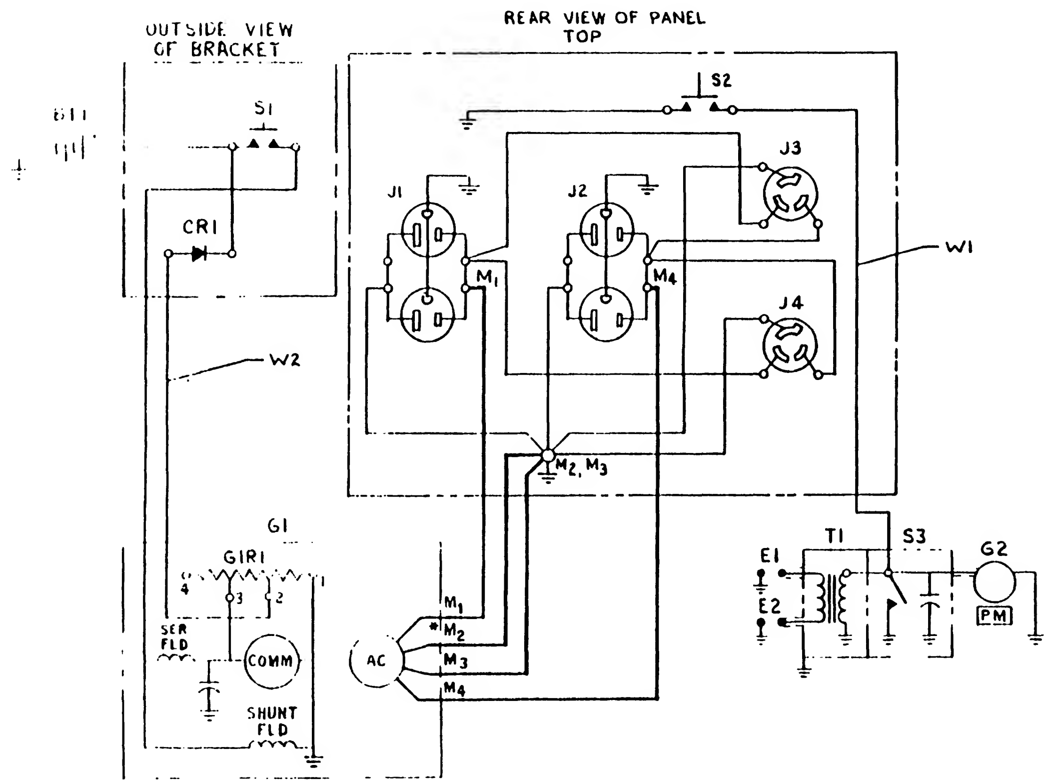
606B198		MODEL NO	
-01	5.5NH-53E/2773A	6.5 NH-3CE/11374C 6.5 NH-3E/2236A	
	120/240V, 1PH, 4W, 50 CY	120/240 V, 1PH, 4 W, 50 CY	

Onan DIVISION OF STUDEBAKER CORPORATION Minneapolis, Minnesota

DATE	DR	CKD
7-15-70	CDR	HPM

NAME: CONTROL-ENG GEN (WIRING DIAGRAM)

DWG NO: 606B198



* GROUNDED AC LEAD, OTHERS HAVE .1 MFD CAPACITOR TO GROUND IN GEN

PARTS LIST

REF DES	DESCRIPTION
CR1	RECTIFIER
	BRKT RECTIFIER MTG
J1, J2	RECEPTACLE DUPLEX 120 V
J3, J4	RECEPTACLE TWISTLOCK 240V
S1	SWITCH START
S2	SWITCH STOP
	BRACKET ASSY CONTROL 01 ONLY
	BRACKET CONTROL MTG 02 ONLY
	CONTROL BOX
	PANEL-CONTROL & RCPT
W1	LEAD ASSY
W2	LEAD ASSY
	GROMMET
	SPACER-SWITCH MTG
	SILKSCREEN
BT1	BATTERY
E1, 2	SPARK PLUG
G1	GENERATOR
G1R1	RESISTOR-GENERATOR
G2	MAGNETO
S3	BREAKER & CAP ASSY
T1	COIL-IGNITION

CONTRACTORS MODEL SPEC D

606B203

	MODEL NO.
01	4.0 & 5 OCCK-3CE 2236R
-02	6.5 NH-3CE 2236D 5.0 CCK-3CE 13276R
	120/240 V, 1 PH, 4 W, 60 CY

LET	REVISION		DATE
C	ADDED W1 & W2		4-24-73
B	[illegible]		[illegible]
A	WAS 323-11		11-10-72

Onan — Division of Studebaker Corporation, Minneapolis, Minnesota

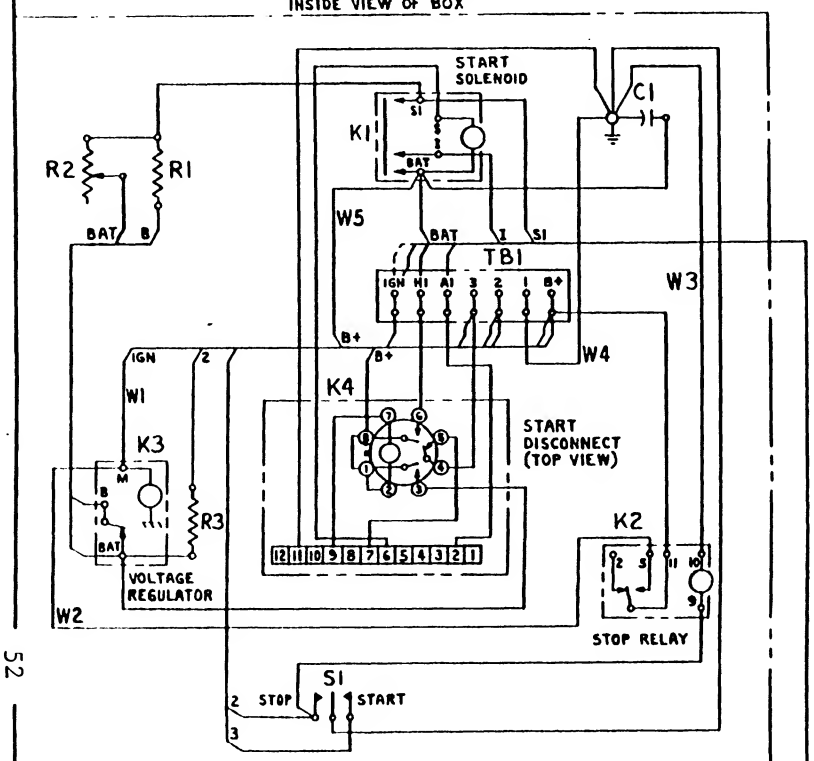
DATE 4-17-72 — DR CDP — CK GET

NAME: CONTROL - GEN SET (WIRING DIAGRAM)

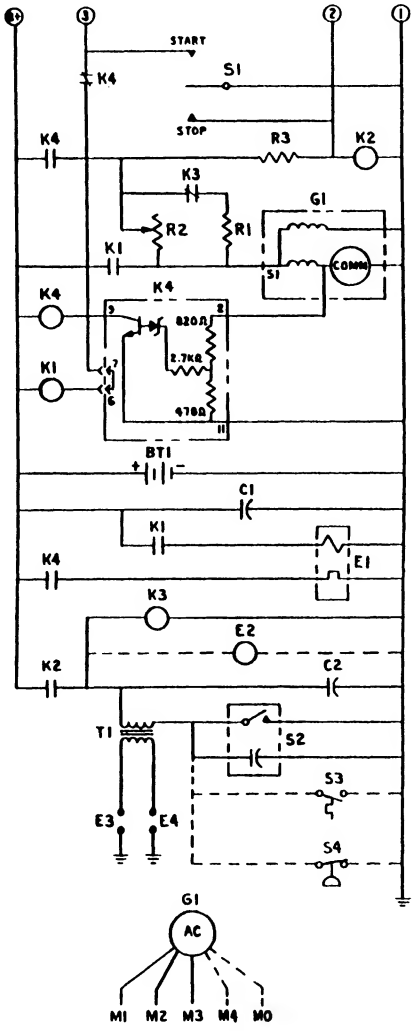
DWG NO 606B203

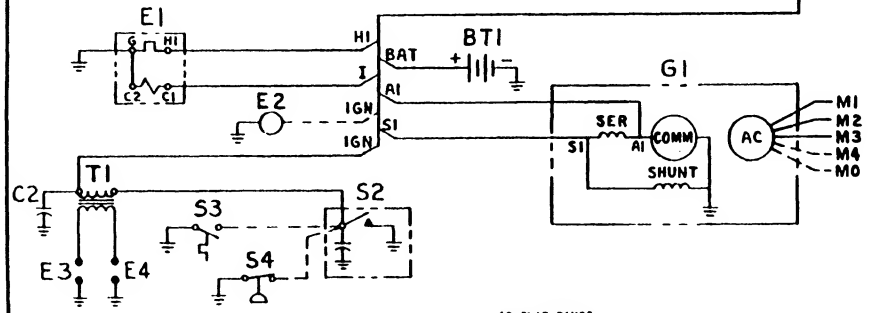
611C1052

WIRING DIAGRAM
INSIDE VIEW OF BOX



SCHEMATIC





PARTS LIST

REF. DES.	PART NO.	QTY.	DESCRIPTION
C1	312A185	1	CAPACITOR ASSY, 1 0 MFD
K1	307B845	1	RELAY-START SOLENOID
K2	307B1052	1	RELAY STOP
K3	305B383	1	RELAY 2 STEP VOLTAGE REGULATOR
K4	306B232	1	RELAY ASSY-START DISC
	307B1078(REF)	1	RELAY-START DISCONNECT
	300A234(REF)	1	AMPLIFIER-START DISCONNECT
	304A688	1	RESISTOR & LEAD ASSY
R1	353A6 (REF)	1	RESISTOR, 6Ω, 50 W
	304A689	1	RESISTOR & LEAD ASSY
R2	304A632(REF)	1	RESISTOR, 6Ω, 100 W ADJ
	304A685	1	RESISTOR & LEAD ASSY
R3	304A251(REF)	1	RESISTOR, 30Ω, 5 W
	308A296	1	SWITCH ASSY-
S1	308P154(REF)	1	SWITCH-START, STOP
TB1	332A745	1	TERMINAL BLOCK
	332A1321	1	MARKER STRIP
W1	336A2032	1	LEAD ASSY
W2	336A2030	1	LEAD ASSY
W3	336A2031	1	LEAD ASSY
W4	336A1431	1	LEAD ASSY
W5	336A2033	1	LEAD ASSY
	301D3351	1	CONTROL BOX
	301B3349	1	COVER-CONTROL BOX
	331-BB	2	GROMMET
	508-4	1	GROMMET
	98A1876	1	SILKSCREEN-RECONNECTION
	98A2266	1	SILKSCREEN-START, STOP

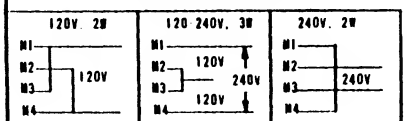
PARTS LIST ENG GEN (REF)

BT1		1	BATTERY, 12V
C2		1	CAPACITOR, 0.1 MFD
E1		1	CHOKE-THERMO MAG
* E2		1	PUMP-FUEL
E3,4		2	SPARK PLUG
G1		1	GENERATOR
S2		1	BREAKER & CAP ASSY
* S3		1	SWITCH-HIGH AIR TEMP
* S4		1	SWITCH-LOW OIL PRESS
I1		1	COIL-IGNITION

611C1052

*WHEN USED

PLACE SILKSCREEN ON INSIDE OF COVER
RECONNECTION FOR 3C



AC SLIP RINGS

M4 M3 M3	M3 M2 M2	M2* MO* MO*	M1 M1 M1	3C 120 240V. 1PH. 4 120 208V. 3PH. 5D 120 240V. 3PH.
COMM END			BEARING END	

*GROUND AC LEAD, ALL OTHERS HAVE 0 1 MFD CAPACITOR TO GROUND

MOBILE GENERATOR SET SPEC A

-01	MODEL NO. NH-** R/6000A	12V REMOTE

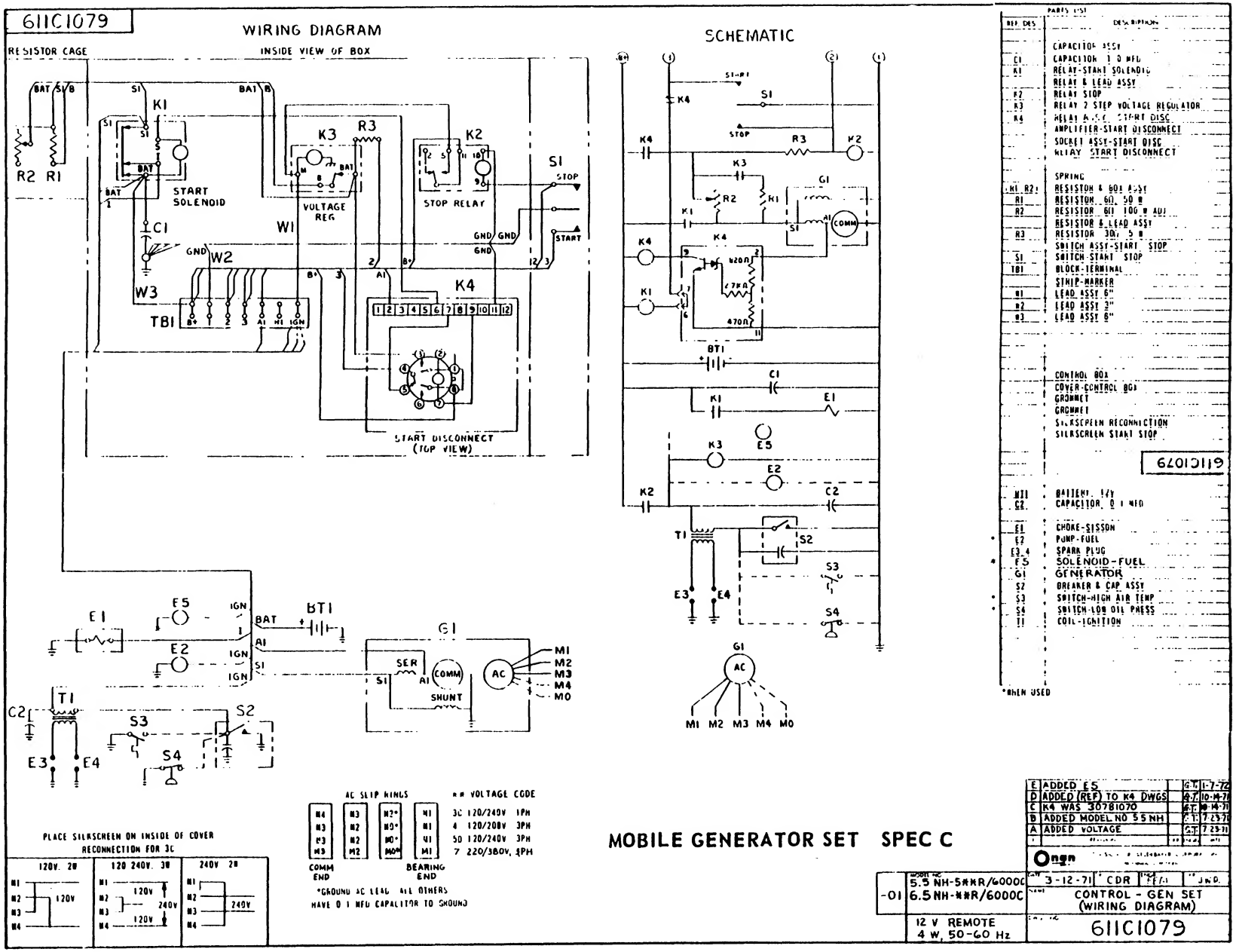
C	WAS 5		ST. 2-27-70
B	WAS -NNCR		ST. 2-27-70
A	MOVED WIRE FROM K4-2	WHB	HBM 9-4-70
SUPSDS DWG SAME NO. DATED 5-4-70			
LET	REVISION	ENG	DATE

Onan DIVISION OF STUDEBAKER CORPORATION

DATE B-24-70 | DR. CDR | ENG. ABM | ** WHB

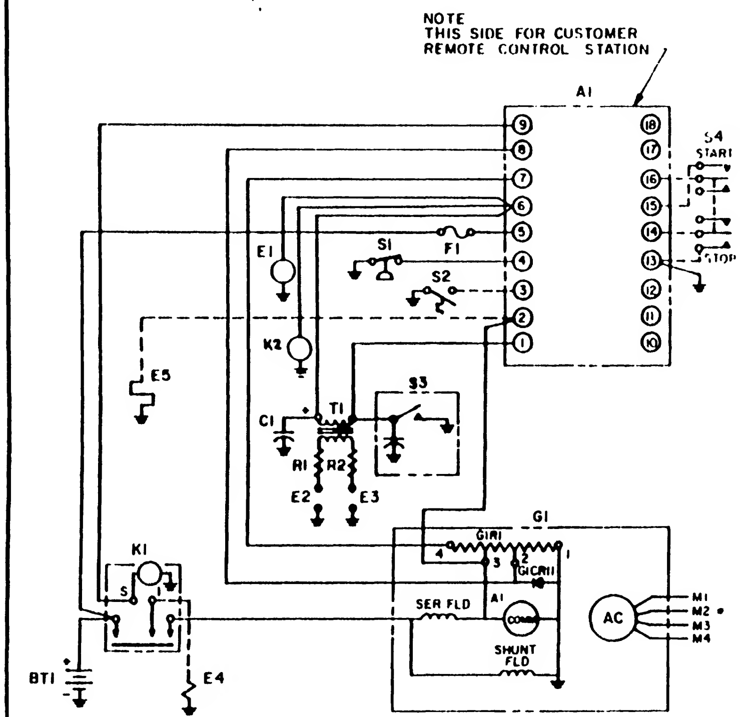
NAME CONTROL - GEN SET (WIRING DIAGRAM)

DWG NO. 611C1052

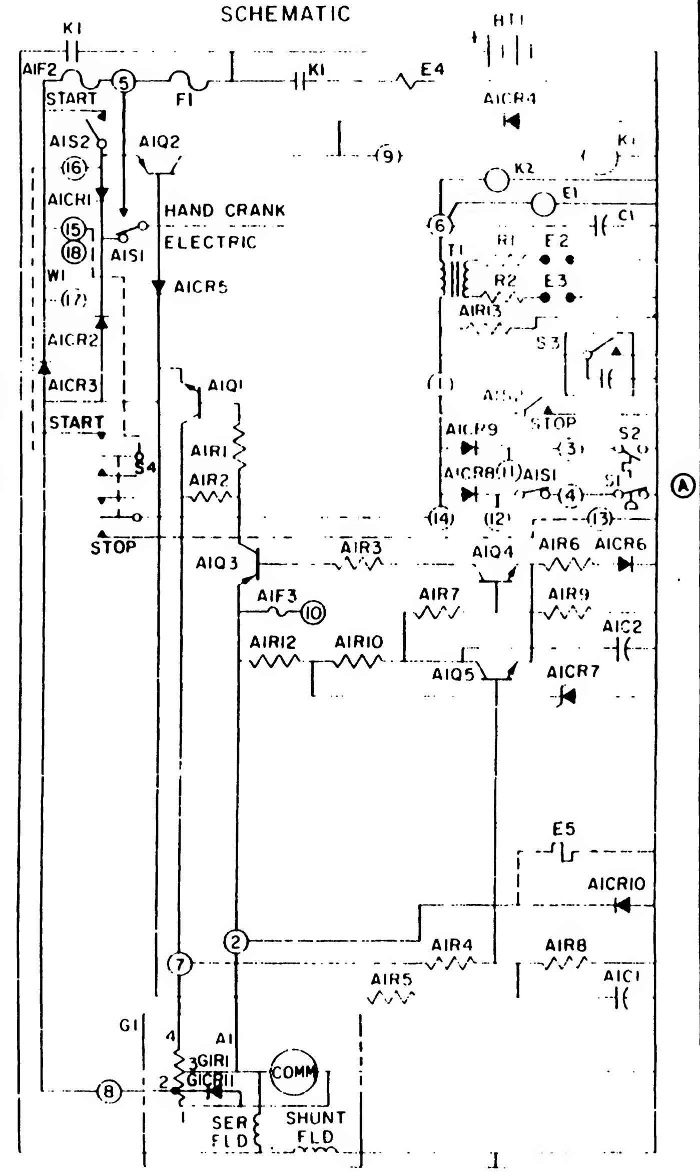

61IC1079
WIRING DIAGRAM
RESISTOR CAGE
INSIDE VIEW OF BOX
SCHEMATIC
START SOLENOID
VOLTAGE REG
STOP RELAY
START DISCONNECT (TOP VIEW)
PLACE SILKSCREEN ON INSIDE OF COVER
RECONNECTION FOR 3C
120V. 2W
120 240V. 3W
240V 2W
AC SLIP RINGS
COMM END
BEARING END
*GROUND AC LEAD ALL OTHERS HAVE 0.1 MFD CAPACITOR TO GROUND
VOLTAGE CODE
3C 120/240V 1PH
4 120/208V 3PH
5D 120/240V 3PH
7 220/380V 3PH
MOBILE GENERATOR SET SPEC C
PARTS LIST
61IC1079
*WHEN USED
E ADDED E5
D ADDED (REF) TO K4 DWGS
C K4 WAS 30781070
B ADDED MODEL NO 5.5 NH
A ADDED VOLTAGE
Onan
5.5 NH-5**R/6000C
-01 6.5 NH-**R/6000C
12 V REMOTE
4 W, 50-60 Hz
3-12-71 CDR
CONTROL - GEN SET (WIRING DIAGRAM)
61IC1079

6IIC1086

WIRING DIAGRAM



SCHEMATIC

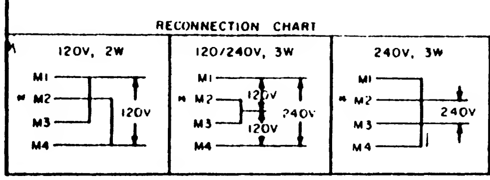


PARTS LIST

REF DES	DESCRIPTION
	CONTROL ASSY
A1	CONTROL GEN SET ASSY
A2	CONTROL-START ADAPTER (4 TO 3 WIRE)
S4	SWITCH START STOP (CUSTOMER REMOTE)
W1	WIRING HARNESS
	LIST ENG GEN (REF)
BT1	BATTERY-12 VDC
C1	CAPACITOR 0.1 MFD
E1	PUMP FUEL (WHEN USED)
E2 E3	SPARK PLUG
E4	CHOKE [illegible] (WHEN USED)
E5	CHOKE ONAN (WHEN USED)
G1	GENERATOR
GICRII	DIODE 3A
GIRI	RESISTOR
K1	RELAY START SOLENOID
F1	FUSE 3A
K2	SOLENOID - FUEL
R1	LEAD ASSY HI TENSION
R2	LEAD ASSY HI TENSION
R11	RESISTOR HYTEMCO 1.72Ω 25W
S1	SWITCH LOW OIL PRESS
S2	SWITCH HIGH AIR TEMP (WHEN USED)
S3	BREAKER & CAP ASSY
S4	SWITCH-REMOTE START STOP
T1	COIL IGNITION

6IIC1086

RECONNECTION CHART



* GROUNDED AC LEAD

MOBILE GENERATOR SPEC D

5.5NH 53CR/12000D		6.5NH 3CR/12000D	
5.84[illegible] 53CR/12000R		4.5CCK 3CR/12000R	
120/240V, 4W.	1 PH 50Hz	120/240V., 4W.	1 PH 60Hz

A ADDED FUEL SOLENOID

SUPERSEDES DWG SAME NO DATED 11-17-71

Onan

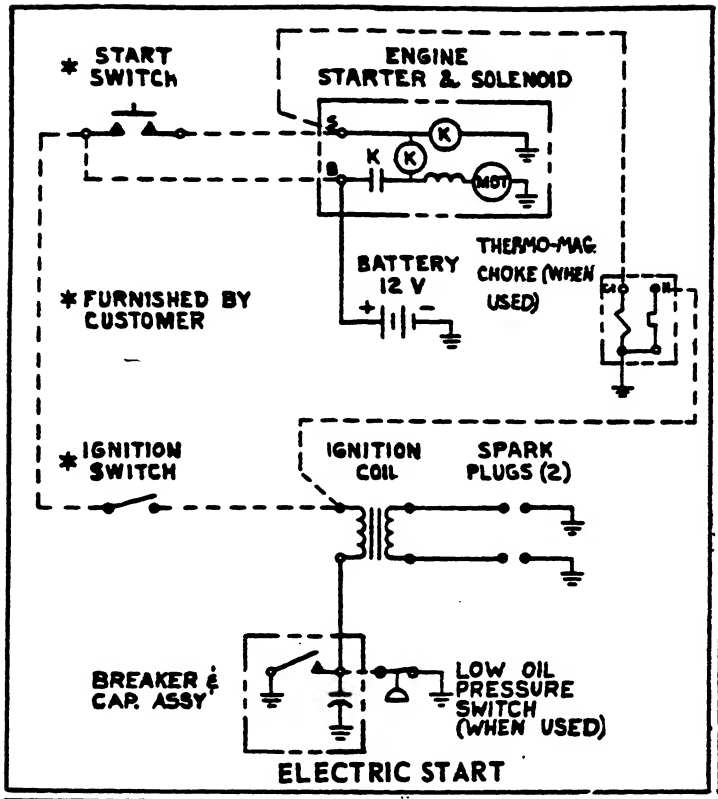
2-15-73 JTM

CONTROL GEN SET
WIRING DIAGRAM

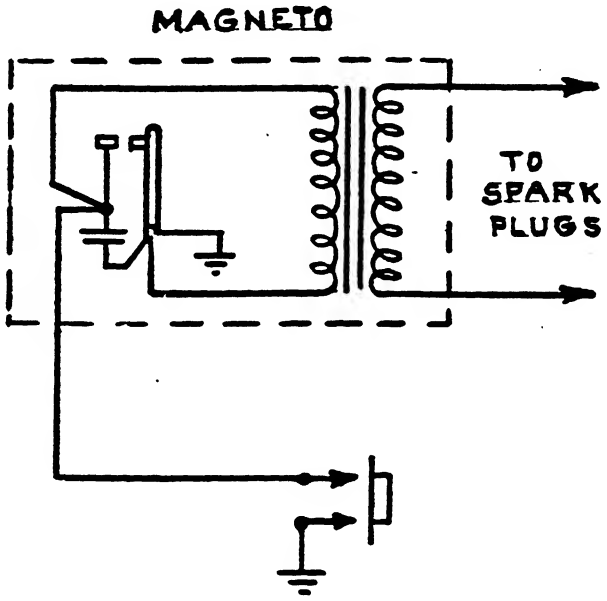
6IIC1086

WIRING DIAGRAMS

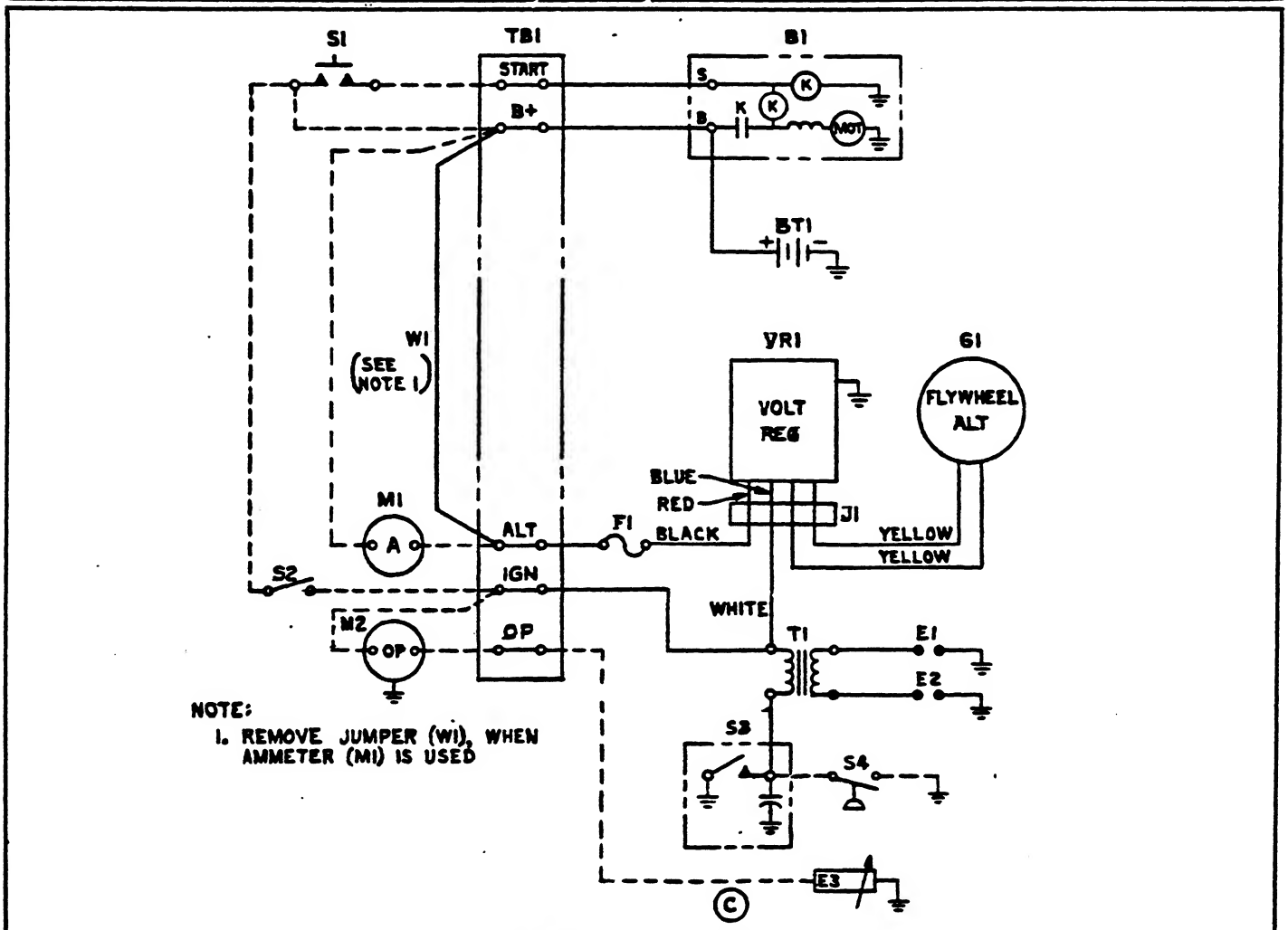
The wiring diagrams on the following page are typical and apply only to standard NH series engines. Wiring diagrams for special models are available on request from the factory: send engine model, spec and serial numbers with the request.



ELECTRIC START



MANUAL START



ELECTRIC START WITH OPTIONAL FLYWHEEL ALTERNATOR